PowerHub
ATM Software Reference Manual

MANU0271-01 Rev A - November 7, 1997

Software Version PH_FT 4.0.0

FORE Systems, Inc.

1000 FORE Drive
Warrendale, PA 15086-7502
Phone: 412-742-4444
FAX: 412-742-7742

http://www.fore.com

Legal Notices

FCC CLASS A NOTICE

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void this user's authority to operate this equipment.

NOTE: The PowerHub 7000 and PowerHub 8000 have been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15, FCC Rules. These limits are designed to provide reasonable protection against harmfull interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

DOC CLASS A NOTICE

This digital apparatus does not exceed Class A limits for radio noise emission for a digital device as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de la class A prescrites dans le reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

VCCI CLASS 1 NOTICE

この装置は、第一種情報処理装置（商工業地域において使用されるべき情報処理装置）で商工業地域での電波障害防止を目的とした情報処理装置等電波障害自主規制協議会(VCCI)基準に適合しております。

従って、住宅地域またはその隣接した地域で使用すると、ラジオ、テレビジョン受信機等に受信障害を与えることがあります。

取扱説明書に従って正しい取り扱いをして下さい。

This equipment is in the Class 1 category (Information Technology Equipment to be used in commercial and/or industrial areas) and conforms to the standards set by the Voluntary Control Council For Interference by Information Technology Equipment aimed at preventing radio interference in commercial and/or industrial areas.Consequently, when used in a residential area or in an adjacent area thereto, radio interference may be caused to radios and TV receivers, etc. Read the instructions for correct handling.

CE *NOTICE*

Marking by the symbol **CE** indicates compliance of this system to the EMC (Electromagnetic Compatibility) directive of the European Community and compliance to the Low Voltage (Safety) Directive. Such marking is indicative that this system meets or exceeds the following technical standards:

- EN 55022 - “Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment.”
- EN 50082-1 - “Electromagnetic compatibility - Generic immunity standard Part 1: Residential, commercial, and light industry.”

SAFETY CERTIFICATIONS

ETL certified to meet Information Technology Equipment safety standards UL 1950 3rd Edition, CSA22.2, No. 950-95, EN 60950 (1992) and IEC 950, 2nd Edition.

CANADIAN IC CS-03 COMPLIANCE STATEMENT

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada label does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

Table of Contents

List of Figures

List of Tables

Preface

This manual describes the *PowerHub* Asynshronous Transfer Mode (ATM) command subsystems. For information on Boot PROM commands, refer to *PowerHub Hardware Reference Manual*. For information on other command subsystems, refer to *PowerHub Software Reference Manual*. For information on applying and configuring filters, refer to *PowerHub Filters Reference Manual*.

Chapter Summaries

Chapter 1 - ATM Commands - Describes commands for configuring and managing the PowerHub switch as an ATM router.

Chapter 2 - RFC-1483 Bridge Encapsulation over PVC - Describes commands for connecting the PowerHub switch to an ATM backbone.

Chapter 3 - Routed 1483 over ATM - Describes commands for connecting the PowerHub switch as a routed backbone.

Chapter 4 - LANE LEC Configuration - Describes commands for overlaying your Ethernet and FDDI LANs on top of an ATM network.

Chapter 5 - FORE IP - Describes commands for using FOREIP to emulate basic characteristics of an IP network.

Chapter 6 - Classical IP over ATM - Describes commands for using CLIP to transmit IP datagrams and Address Resolution Protocol (ARP) requests and replies over ATM using AAL5.

Chapter 7 - Classical IP PVC over ATM - Describes commands for using CLIP to transmit IP datagrams and ARP through the ATM backbone.

Related Publications

- PowerHub Hardware Reference Manual, MANU0166-01, November 7, 1997
- PowerHub Software Reference Manual, MANU0167-01, November 7, 1997
- PowerHub Filters Reference Manual, MANU0168-01, November 7, 1997

Technical Support

In the U.S.A., you can contact FORE Systems' Technical Support using any one of the following methods:

1. If you have access to the Internet, you may contact FORE Systems' Technical Support via e-mail at:

   support@fore.com

2. You may FAX your questions to "support" at:

   412-742-7900

3. You may send questions, via U.S. Mail, to:

   FORE Systems, Inc.
   1000 FORE Drive
   Warrendale, PA 15086-7502

4. You may telephone your questions to "support" at:

   800-671-FORE or 412-635-3700

Technical support for non-U.S.A. customers should be handled through your local distributor.

No matter which method is used for support, please be prepared to provide your support contract ID number, the serial number(s) of the product(s), and as much information as possible describing your problem / question.

Typographical Styles

Throughout this manual, all specific commands meant to be entered by the user appear on a separate line in bold typeface. In addition, use of the `Enter` or `Return` key is represented as `<ENTER>`. The following example demonstrates this convention:

`cd /usr <ENTER>`

File names that appear within the text of this manual are represented in the following style: "...the `fore_install` program installs this distribution."

Command names that appear within the text of this manual are represented in the following style: "...using the **`flush-cache`** command clears the bridge cache."

Subsystem names that appear within the text of this manual are represented in the following style: "...to access the **`bridge`** subsystem..."

Parameter names that appear within the text of this manual are represented in the following style: "...using *`<seg-list>`* allows you to specify the segments for which you want to display the specified bridge statistics."

Any messages that appear on the screen during software installation and network interface administration are shown in `Courier` font to distinguish them from the rest of the text as follows:

```
.... Are all four conditions true?
```

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to ensure correct and complete installation, as well as to avoid damage to the FORE Systems product or to your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a ***WARNING*** statement until the indicated conditions are fully understood or met. This information could prevent serious injury to the operator, damage to the FORE Systems product, the system, or currently loaded software, and is indicated as follows:

WARNING!

Hazardous voltages are present. To reduce the risk of electrical shock and danger to personal health, follow the instructions carefully.

CAUTION statements contain information that is important for proper installation/operation. Compliance with **CAUTION** statements can prevent possible equipment damage and/or loss of data and are indicated as follows:

CAUTION

You risk damaging your equipment and/or software if you do not follow these instructions.

NOTE statements contain information that has been found important enough to be called to the special attention of the operator and is set off from the text as follows:

NOTE

If you change the value of the LECS control parameters while the LECS process is running, the new values do not take effect until the LECS process is stopped, and then restarted.

Laser Notice

Class 1 Laser Product:
This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

Class 1 lasers are defined as products which do not permit human access to laser radiation in excess of the accessible limits of Class 1 for applicable wavelengths and durations. These lasers are safe under reasonably foreseeable conditions of operation.

NOTE

The Laser Notice section applies only to products or components containing Class 1 lasers.

Safety Precautions

For your protection, observe the following safety precautions when setting up equipment:

- Follow all warnings and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source matches the voltage and frequency inscribed on the equipment's electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous voltages may be present. Conductive foreign objects could produce a short circuit that could cause fire, electric shock, or damage to your equipment.

Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

Placement of a FORE Systems Product

CAUTION

To ensure reliable operation of your FORE Systems product and to protect it from overheating, openings in the equipment must not be blocked or covered. A FORE Systems product should never be placed near a radiator or heat register.

Power Cord Connection

WARNING!

FORE Systems products are designed to work with single-phase power systems having a grounded neutral conductor. To reduce the risk of electrical shock, do not plug FORE Systems products into any other type of power system. Contact your facilities manager or a qualified electrician if you are not sure what type of power is supplied to your building.

WARNING!

Your FORE Systems product is shipped with a grounding type (3-wire) power cord. To reduce the risk of electric shock, always plug the cord into a grounded power outlet.

CHAPTER 1 ATM Commands

This chapter describes the commands that can be found in the **atm** subsystem. These commands are used to configure and manage the PowerHub as an edge device between Ethernet, Fast Ethernet (and FDDI), and ATM. The information in this chapter is for reference. If specific instructions are needed to configure a PowerCell segment to use a specific ATM protocol, see the appropriate chapter:

- To configure parameters for RFC-1483 Encapsulation over PVC, see *Chapter 2, RFC-1483 Bridge Encapsulation over PVC*.
- To configure parameters for Routed 1483 over PVC, see *Chapter 3, Routed 1483 over ATM*.
- To configure LANE 1.0, see *Chapter 4, LANE LEC Configuration*.
- To configure FORE IP, see *Chapter 5, FORE IP*.
- To configure CL IP, see *Chapter 6, Classical IP over ATM*.
- To configure CL IP PVC, see *Chapter 7, Classical IP PVC over ATM*.

1.1 Accessing the ATM Subsystem

To access the **atm** subsystem, issue the following command at the runtime prompt:

```
atm
```

1.1.1 ATM Port (PHY) Selection Commands

The commands in this section enable the selection and display of information on the primary and backup port (PHY) on the PowerCell 700. (See Section 1.1.1.)

1.1.1.1 Selecting a Port

The PowerCell software uses the primary port by default. If the link to the primary port fails, the backup port automatically takes over, provided a redundant link has been established to the port switch. Also, if the backup port is in use and it fails, the software switches back to the primary port.

After the problem that led to the link failure on the primary port is corrected, manually change to the primary port to use it again. Manually switching between the backup and primary ports is done using the **`ama cset`** command.[1]

NOTE

When changing from one port to the other, the connection to the ATM switch (and therefore the ATM network) is temporarily lost while the software switches the connections to the new port.

The syntax for the **`ama cset`** command is:

`active-ama|aa cset p[rimary]|b[ackup]` *<slot>***`|all`**

<slot> Specifies the slot that contains the PowerCell module.

Slots are labeled on the chassis. Slot numbers can also be determined by using the **`system config show`** command.

primary|p | backup|b Selects the port to use. If **`primary`** is specified, the port labeled PRIMARY is used. If **`backup`** is specified, the port labeled BACKUP is used. The default is **`primary`**.

NOTE

If the PowerCell module contains a backup port but the backup port is down, the software attempts to switch to the backup port, recognizes that the port is not available, then immediately switches back to the primary port. Connection to the ATM switch is temporarily lost, then quickly re-established.

The following example selects the primary port. To save the port selection, save the PowerHub configuration using the **`system`** or the **`tftp savecfg`** commands.

```
117:PowerHub:atm# aa cset p 2
```

---

1. The port-selection commands contain the word “ama” in reference to the AMA (ATM Media Adapter) on the PowerCell 700. Each ATM port on the PowerCell 700 is provided by an AMA.

1.1.1.1.1 Verifying the ATM Port Selection

Use the **ama show** command to indicate the port that has been selected for use and the port that actually is in use. The syntax for this command is:

active-ama|aa [show] [linemode|lm] *<slot>***|all**

show Displays the linemode configured for the ATM card.

linemode|lm Allows you to specify that a linemode is to be configured.

<slot>|all Displays the specific slot you have configured.

Slots are labeled on the chassis. Slot numbers can also be determined using the **system config show** command. If **all** is specified, the AMA information is shown for all PowerCell modules.

Following is an example of the display produced by this command. In this example, the primary port is both selected and in use.

```
1:PowerHub:atm# aa show 4

AMA Configurations for Slot 4:
                    Primary             Backup (Installed)
----------------------------------------------------------
User Selected AMA : PRIMARY
Actual In Use AMA : PRIMARY
PHY UTOPIA Level  : 1                    1
PHY UTOPIA Version: 2                    2
PHY Protocol Type : 155M OC3             155M OC3
PHY Media Type    : Multimode Fiber      Multimode Fiber
```

The fields in this display show the following information:

User Selected AMA The port specified for normal operation. Unless explicitly changing the port assignments, the software uses the primary port by default and the backup port only if the link to the primary port fails.

Actual In Use AMA The port that is being used. If the link to the primary port fails, this field shows that the backup port is in use, even though the primary port was selected for use.

PHY UTOPIA Level The PHY UTOPIA level in use by the PowerCell module and port. UTOPIA is an ATM standard for the communication between the PowerCell module and the PHY (port).

PHY UTOPIA Version The version of the PHY UTOPIA in use by the PowerCell module and the port.

PHY Protocol Type The PHY-layer protocol in use on the port. The protocol must be the following:

155M OC3155 Mb/s using an OC-3 connector.

PHY Media Type The type of cable connecting the port to the ATM switch. The cable type can be one of the following:

Multimode Fiber
Single Mode Fiber
CAT5 UTP

Normally, the primary port is selected by the software and used for ATM traffic between the PowerCell module and the ATM switch. However, if the primary link fails or is changed to the backup port, the PowerCell uses the backup port. The **aa show** command shows that the backup port is in use as follows:

```
2:PowerHub:atm# aa show 4
AMA Configurations for Slot 4:
                    Primary             Backup (Installed)
----------------------------------------------------------
User Selected AMA : PRIMARY
Actual In Use AMA :                      BACKUP
PHY UTOPIA Level  : 1                    1
PHY UTOPIA Version: 2                    2
PHY Protocol Type : 155M OC3             155M OC3
PHY Media Type    : Multimode Fiber      Multimode Fiber
```

Notice that the `Actual In Use` AMA field lists the backup port in use, even though the primary port is selected. To use the primary port again, correct the problem that caused the primary link to fail, then use the **aa cset** command to select the primary port. (See Section 1.1.1.)

1.1.1.2 Setting the Backup Linktimer

Set a default linktimer value if the link to the primary port fails. Before the backup port automatically takes over with primary port failure, the PowerHub waits for a time period to determine whether the primary port recovers, provided the linktimer value is set with the **active-ama cset** command. The syntax for the **ama cset** command is:

active-ama|aa cset linktimer|lt *<time_sec> <slot>***|all**

linktimer|lt Specifies the default linktimer setting with the **cset** command. The PowerCell 700 waits for the duration of time set in link-down condition before switching to the back-up PHY.

<time_sec> Specifies the amount of time in seconds before the primary port switches to the backup port. The range of value is between **2.5** to **600** seconds. The default is **2.5** seconds.

<slot>|all Specifies the slot that contains the PowerCell module.

Slots are labeled on the chassis. Slot numbers can also be determined by using the **system config show** command.

Following is an example of this command:

```
117:PowerHub:atm# aa cset lt 30 2
```

1.1.1.2.1 Verifying the Backup Linktimer

Use the **ama show** command to display the linktimer value for backup port switchover. The syntax for this command is:

active-ama|aa [show] [linktimer|lt] *<slot>***|all**

show Displays the linemode configured for the ATM card.

linktimer|lt Specifies the default linktimer setting with the **cset** command. The PowerCell 700 waits for the duration of time set in link-down condition before switching to the back-up PHY.

<slot>|all Displays the specific slot you have configured.

Slots are labeled on the chassis. Slot numbers can also be determined by using the **system config show** command. If **all** is specified, the AMA information is shown for all the PowerCell modules in the chassis.

Following is an example of the display produced by this command. In this example, the primary port is both selected and in use.

```
1:PowerHub:atm# aa show lt all
Slot 2 linkdown_timer 30
2:PowerHub:atm#
```

1.1.1.3 Displaying and Clearing Statistics

To display statistics for the active AMA selected port, use the **stats show** command. The syntax for this command is:

stats [show] active-ama|aa *<slot>***|all**

active-ama|aa Displays the active AMAs on the specified slot.

<slot>|all Displays the specific configured for AMAs.

Following is an example of the display produced by this command.

```
1:PowerHub:atm# stats show aa all
PHY Type: OC3
Slot: 1
Multi-errored cell:       0
Path RDI soak:          27ms
B1 block error:           0
B2 block error:           0
B3 block error:           0
B1 coding violation:      0
B2 coding violation:      0
B3 coding violation:      0
```

The fields in this display show the following information:

PHY Type The type of the PHY in use by the PowerCell module and the port.

Slot The port that is actually being used. If the link to the primary port fails, this field shows that the backup port is in use, even though the primary port was selected for use.

Multi-errored cell The ATM cells that are received with multiple-bit errors in the 5-byte ATM header.

Path RDI soak The amount of time that a loss-of-cell-alignment (LOCA) condition must be present before a path RDI condition is sent via the outgoing G1 byte.

B1/B2/B3 block error Displays the total number of frames received with B1, B2, and B3 errors.

B1/B2/B3 coding violation Displays the total number of received B1, B2, and B3 bit-interleaved parity (BIP) bits that are in error.

To clear statistics for the active AMA selected port, use the **stats clear** command. The syntax for this command is:

stats clear active-ama|aa *<slot>***|all**

1.1.2 Segment Configuration Commands

The commands in this section configure rate groups and assign an ATM protocol and rate group to each ATM segment.

1.1.2.1 Configuring a Rate Group

Rate groups enable dividing the complete bandwidth into different groups of usage. Up to 16 different groups can be defined by using the **cset** command. To configure a rate group for the PowerCell module, issue the following command.

rate-group|rg cset ***<rate-group> <rate> <slot>***

<rate-group> Specifies the rate group. Specify a number from **1** through **16**. The default rate group for all segments is **1**.

<rate> Specifies the rate in Mb/s or Kb/s.

- To specify the rate in Kb/s, enter “**k**” or “**K**” after the number. For example, to specify 45000 Kb/s, enter the number as **45000k** or **45000K**.
- To specify the rate in Mb/s, enter “**m**” or “**M**” after the number. For example, to specify 45 Mb/s, enter the number as **45m** or **45M**.

If Kb/s or Mb/s is not specified, the software assumes Mb/s.

Specify a rate from 1 to 155000 Kb/s for group 1 or a rate from 0 through 155000 Kb/s for groups 2 through 16. The default for rate group 1 is 155000 Kb/s. The default for rate groups 2 through 16 is 0 Kb/s.

When configuring the rate group, specify a bit rate that is equal to or lower than the maximum bit rate supported by the physical interface type of the ATM port. For example, if the ATM port is an OC-3 port, the port can transmit at 155000 Kb/s or lower. If a rate group with a higher bit rate to the port is applied, the port still transmits at 155000 Kb/s or less.

The PowerCell software uses rate group 1 for all ATM signalling and ILMI traffic. Therefore, do not configure rate group 1 for 0 Kb/s unless ATM signalling and ILMI traffic on the PowerCell module is to be eliminated.

NOTE If rate groups were configured in software versions earlier than 7-2.6.4.0, the PowerHub software converts the rates to Kb/s when saving the configuration file. Therefore the rates are not changed, but their representation is changed.

<slot> Specifies the slot that contains the PowerCell module. Slots are labeled on the chassis. Slot numbers can also be determined using the **`system config show`** command.

NOTE The total for all the rate groups for the PowerCell module must be 155000 Kb/s or less.

Following is an example of the **`rate-group cset`** command.

```
3:PowerHub:atm# rg cset 4 3 1
```

1.1.2.2 Displaying Rate Groups

To display configuration information about the rate groups configured for the PowerCell module, issue the following command:

`rate-group|rg [show]` *<slot>***`|all`**

<slot>|all Specifies the slot that contains the PowerCell 700. Slots are labeled on the chassis. Slot numbers can also be determined by using the **`system config show`** command. If **`all`** is specified, the rate groups for all the PowerCell modules are displayed.

Following is an example of the information displayed by this command. In this example, the rate group configuration for the PowerCell module in slot 4 is displayed.

```
3:PowerHub:atm# rg show 4
Rate Group Settings For Slot: 4
-------------------------------------------------------
Group  1:  100000 Kbps
Group  2:    6000 Kbps
Group  3:    3000 Kbps
Group  4:    4000 Kbps
Group  5:       0 Kbps
Group  6:       0 Kbps
Group  7:       0 Kbps
Group  8:       0 Kbps
Group  9:       0 Kbps
Group 10:       0 Kbps
Group 11:       0 Kbps
Group 12:       0 Kbps
Group 13:    5000 Kbps
Group 14:    6000 Kbps
Group 15:    7000 Kbps
Group 16:    8000 Kbps
Total   :  139000 Kbps
Idle    :   16000 Kbps
```

As shown in this example, the Kb/s allocated to each of the 16 rate groups is listed. Following the listings for the individual rate groups, this display lists the total Kb/s allocated among all 16 rate groups and the amount of idle (unallocated) Kb/s, if any.

1.1.2.3 Configuring ATM Segments

Up to 32 logical segments on the PowerCell 700. For each segment, the protocol and the rate group used by that segment can be specified. Each segment on the PowerCell module can be configured for only one protocol and one rate group.

NOTE

The segments must already be allocated to the chassis slot that contains the PowerCell module. Allocate segments using the **nvram set slotsegs** command.

To configure the protocol and rate group for a segment on the PowerCell module, issue the following command:

protocol|proto sset *<proto>* **<seglist>|all**

<proto> Specifies the protocol to be used on a segment. Specify one of the following:

fore-ip | fip
lane | l
classical-ip | c
classical-ip-pvc | cp
routed-1483 | r1483
bridge-encap | b
None | n

NOTE

RFC-1483 Encapsulation, FORE IP, and CLIP are supported only on the PowerCell 700, and only in software version 7-2.6.4.0 and greater.

<segment-list>|all Specifies the PowerCell segment being configured. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If **all** is specified, all the segments on all PowerCell modules in the chassis are configured to use the ATM protocol and rate group specified.

To configure the rate group for a segment on the PowerCell module, issue the following command:

sset rate-group|rg 1|2|3|4 *<segment>***|all**

1|2|3|4 Associates a segment with a rate group. Specify a rate group number from **1** through **4**. The default rate group for all segments is **1**.

<segment>|all Specifies the PowerCell segment being configured. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If **all** is specified, all segments on all PowerCell modules in the chassis are configured to use the ATM protocol and rate group specified.

1.1.2.4 Displaying Configuration for ATM Segments

To display configuration information for segments on a PowerCell module, issue the **config** command. This command displays the protocol and rate group configured on the specified segment(s) using the **config** command. (See Section 1.1.2.3.)

config [show] [s[egments]=]<*seglist*>**|slot=**<*slot#*>**|all**

<seglist> .Specify an individual segment number, a comma-separated list of segment numbers, or a hyphen-separated range of segment numbers.

<slot#> Specifies the slot number.

Following is an example of the information displayed by this command. In this example, the ATM configuration for segment 19 is displayed.

```
4:PowerHub:atm# config show 2.4

   Segment          Protocol         State      Rate Group
  ----------    -----------------  ---------   ----------
     2.4              None           Disabled       1
```

The fields in this display show the following information:

Segment Lists the PowerHub segment.

Protocol Lists the ATM protocol assigned to the segment. The protocol can be one of the following:

fore-ip | fip
lane | l
classical-ip | c
classical-ip-pvc | cp
routed-1483 | r1483
bridge-encap | b
None | n

State Indicates the state of the protocol. If the protocol is disabled, enable it using the appropriate command:

- To enable the FORE IP protocol, use the `atm/foreip` **`senable`** command.
- To enable the LANE 1.0 protocol, use the `atm/lane` **`lec cenable`** command.

- To enable the CLIP protocol, use the `atm/clip` **`senable`** command.
- To enable RFC-1483 Encapsulation, use the `atm/1483routed` **`senable`** command.

Rate-Group Indicates the rate group assigned to the segment.

1.1.2.5 Displaying VCs for Specified ATM Segments

To display the active virtual circuits (VCs) on specified segments, issue the **`vc show`** command. This command displays the number of VCs configured on the specified segments. The syntax for this command is:

`vc [show]` ***`<seglist>`*****`|all`**

<seglist>|all Specifies the segment number to display. If **`all`** is specified, the information is listed for all active segments.

The following information is listed:

For each LANE-enabled segment:
LEC Configuration Direct PP SVC
LEC Control Direct PP SVC
LEC Control Distribute PMP SVC
LEC Multicast Send PP SVC
LEC BUS Multicast Forward PMP SVC

For FORE-IP-enabled segments: All FOREIP Input and Output SVCs.

For each 1483-Bridge-Encapsulation-enabled segment: Input and output 1483 PVCs.

For each CLIP-enabled segment:
SVC to CLIP ARP Server on same LIS.
All SVCs to remote CLIP clients on same LIS.

Following is an example of the information displayed by the **`vc show`** command. In this example, only segment 19 has active VCs and of the 32 segments on the PowerHub, only two are configured. Segment 14 has been configured for a protocol, but does not currently have any active VCs. The PVCs that are shown at the bottom of the display are for signalling purposes and should not be removed.

```
31:PowerHub:atm# vc show all
Total Active VCs on Segment 14: 0
Total Active VCs on Segment 19: 2
 Inbound: 300
Outbound: 400
Active Signaling PVCs < 32 on ATM Slot 2:
 5 16
Total Active VCs on ATM Slot 2: 4
```

CHAPTER 2 RFC-1483 Bridge Encapsulation over PVC

This chapter describes the PowerHub support for RFC-1483 Encapsulation over PVC (hereafter called RFC-1483 Encapsulation). *RFC-1483 Encapsulation* provides a simple mechanism for encapsulating MAC layer frames and using Permanent Virtual Circuits (PVCs).

Use RFC-1483 Encapsulation if the PowerHub is to be connected to an ATM backbone. RFC-1483 requires fewer configuration steps than LANE 2.0, Classical IP over ATM, and FORE IP.

Note that RFC-1483 Encapsulation does not provide ARP services or broadcast/multicast services. Consequently, if the network is dynamic and requires these services, use LANE 2.0, Classical IP, or FORE IP instead of RFC-1483 Encapsulation.

This chapter shows how a PowerCell module configured for RFC-1483 Encapsulation fits into the ATM network and describes how to configure a PowerCell segment for RFC-1483 Encapsulation.

NOTE

Routed 1483 Bridge over ATM does not use Signalling. RFC 1483 specifies bridging Ethernet, FDDI, or Token Ring frames across the PVC. The PowerHub supports only Ethernet in the PH_FT4.0.0 Software release.

2.1 The PowerCell Module and RFC-1483 Encapsulation

When configuring a PowerCell segment for RFC-1483 Encapsulation, configure a PVC from one PowerHub to another, which traverses the ATM switch. To configure the PVC, assign an incoming Virtual Circuit ID (VCI) and an outgoing VCI to the segment. The VCs are unidirectional. The following figure shows an example of a connection between a PowerCell module and an ATM network using RFC-1483 Encapsulation.

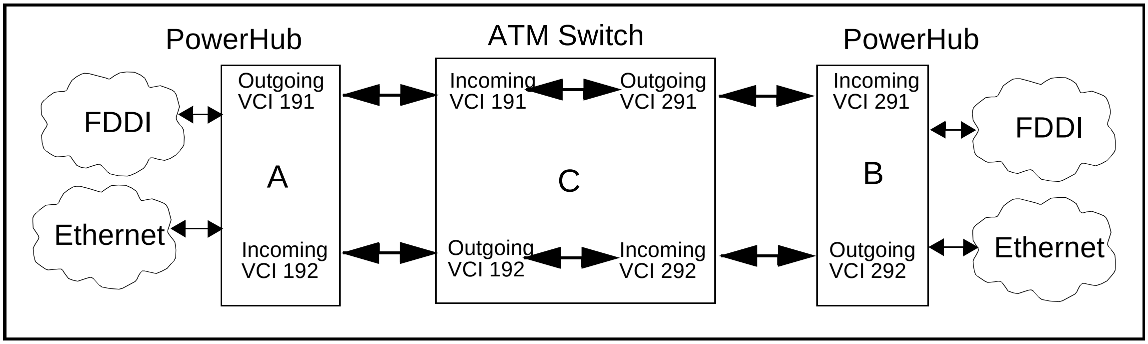

Figure 2.1 - RFC-1483 Encapsulation and PowerCell Module.

For each PowerCell segment using RFC-1483 Encapsulation, configure an incoming VCI and outgoing VCI on the ATM switch and on the PowerCell module to which the ATM switch is attached. The incoming VCI number on the PowerCell segment must match the outgoing VCI on the ATM switch's port. Likewise, the outgoing VCI number on the PowerCell segment must match the incoming VCI on the ATM switch's port.

In this example, VCI 191 is an outgoing VCI on the PowerCell module of PowerHub "A", the incoming VCI on one port of ATM switch "C", the outgoing VCI on a different port of ATM switch "C", and an incoming VCI on the PowerCell module of PowerHub "B". VCI 192 follows a similar path in the other direction, using the same ports. In the example, one PVC makes each unidirectional connection between the PowerHubs; the PVC from PowerHub "A" to ATM switch "C", and the PVC from ATM switch "C" to PowerHub "B" form the first connection, and the second is formed in the other direction.

By configuring incoming and outgoing VCIs between the PowerCell modules and the ATM switch, the PowerHubs and the ATM switch can **bridge** and **route** traffic between the ATM network and the Ethernet and / or FDDI LANs.

Configure one RFC-1483 Encapsulation PVC on each PowerCell segment unless the virtual segment is running another datalink protocol. The PowerCell module supports up to 32 virtual segments, all of which can be allocated to RFC-1483 Encapsulation PVCs if no other datalink protocols are assigned.

2.2 Configuring a PowerCell Segment for RFC-1483

To use the PowerCell module for RFC-1483 Encapsulation, perform the following configuration tasks:

- Configure RFC-1483 Encapsulation on the segment (**`senable command`**).
- Enable RFC-1483 Encapsulation on the segment (**`senable command`**).
- Verify the RFC-1483 Encapsulation configuration and operation (**`config show`** command).

The following sections describe how to perform these tasks.

2.2.1 Configuration Considerations

Before configuring the PowerCell module for RFC-1483 Encapsulation, make sure the configuration plans are not affected by the following considerations:

- The PowerHub implementation of RFC-1483 Encapsulation allows connections only using Permanent Virtual Circuits (PVCs). Specify the VCIs for a PowerCell segment when configuring the segment for RFC-1483 Encapsulation.
- VC-based multiplexing (described in Section 5 of RFC 1483) is not supported.
- All outgoing packets (packets sent from the PowerCell module to the ATM switch) are sent with the CRC stripped (PID: 0x0007). The ATM switch accepts 0x0001 or 0x0007. The PowerCell sends 0x0007.
- The PowerCell module accepts only PDUs that use Ethernet / 802.3 encapsulation. All other PDUs are discarded by the PowerCell module.
- If there are any other protocols configured on the segment, such as FORE IP or LANE, they must first be deleted.

2.2.2 Enabling RFC-1483 Encapsulation on a Segment

Before enabling RFC-1483 Encapsulation on a segment, configure the PowerCell segment using the **`atm sset protocol`** command. To configure the PowerCell segment, telnet into or connect to the PowerHub through the TTY interface, change to the **`atm`** subsystem, and configure the desired segment.

NOTE

When accessed from within a subsystem, commands do not need to contain the subsystem prefix. Thus, the **`atm sset protocol`** command can be used from within the **`atm`** subsystem by typing **`sset protocol`**. All commands in this manual issued on the PowerHub are located in the **`atm`** subsystem unless otherwise noted.

17:PowerHub:atm#**sset proto b 1.5**

The above command configures segment 1.5 to use PVC Bridging.

After enabling bridge encapsulation on a PowerCell Segment, then enable RFC-1483 on the segment. To get to the RFC-1483 Encapsulation subsystem, issue the following command:

`atm/1483encap`

Once in the **`1483/encap`** subsystem, to enable RFC-1483 Encapsulation on a PowerCell segment, issue the following command:

`senable` *`<seglist>`*

<seglist> Specifies the PowerCell segment on which to enable RFC-1483 Encapsulation.

Following is an example of this command. The command configures PowerHub segment 2.2 to enable RFC-1483 Encapsulation on the segment.

```
10:PowerHub:atm/1483encap# senable proto b 2.2
Okay
```

Use the **`in-pvc`** and **`out-pvc`** parameters when enabling RFC-1483 Encapsulation on the segment using the **`senable`** command. However, only the segment number and state parameters are needed when disabling RFC-1483 Encapsulation on the segment. When a segment is disabled, both incoming and outgoing VCIs are automatically deleted from the segment.

Following is an example of the command to disable RFC-1483 Encapsulation on the segment that was enabled in the previous example.

```
10:PowerHub:atm/1483encap# sdisable proto b 2.2
Okay
```

2.2.3 Verifying PowerCell 1483 Encap Configuration

The incoming and outgoing VCIs and packet statistics for a PowerCell segment that is enabled for RFC-1483 Encapsulation can be displayed by issuing the following command:

config [show] *<seglist>***|all**

<segment>|all Specifies the PowerCell segment(s) to display the PVC configuration and statistics. Specify a single segment number or all segments. If **all** is specified, PVC information is displayed for all the PowerCell segments in the chassis on which RFC-1483 Encapsulation is enabled.

Following is an example of this command. In this example, PVC information is displayed for port 8.

```
12:PowerHub:atm/1483encap# config show all
RFC-1483 encapsulation information for port 8
    In PVC VCI:                      182
    Out PVC VCI:                     181
    Total Pkts sent:                 25
    Total Pkts rcvd:                 322
    Pkts rcvd with unknown type:     0
    Pkts rcvd with unknown protocol: 0
    Pkts rcvd with length too big:   0
```

The fields in this display show the following information:

In PVC VCI The incoming PVC's VCI. Specify this value when configuring a PowerCell segment for RFC 1483 (using the **sset inpvc** command).

Out PVC VCI The outgoing PVC's VCI. Specify this value when configuring a PowerCell segment for RFC 1483 (using the **sset outpvc** command).

Total Pkts sent The number of packets sent on this segment's outgoing PVC. The PowerCell module begins accumulating these statistics when RFC-1483 encapsulation on a segment is enabled.

Total Pkts rcvd The number of packets received on this segment's incoming PVC. The PowerCell module begins accumulating these statistics when RFC-1483 encapsulation on a segment is enabled.

Pkts rcvd with unknown type The number of packets received on this segment's incoming PVC with an unknown type. Any packet that does not contain a SNAP header and an OID of 0080c2 is considered a packet of unknown type.

Pkts rcvd with unknown protocol The PID which is not 0x0001, 0x0007, or 0x000e (STP).

Pkts rcvd with length too big The number of packets received on this segment's PVC with a packet length that is too big. Any packet that exceeds the maximum ethernet packet length of 1518 bytes is considered too big and is dropped.

After displaying the RFC-1483 Encapsulation information, verify that RFC-1483 Encapsulation is operational on the PowerCell module:

1. Check the In PVC VCI and Out PVC VCI fields to make sure they contain the VCIs expected.
2. Place the segment in a live network (if not already done so), then re-issue the **`config show`** command to refresh the display. Check the Total Pkts sent and Total Pkts rcvd fields for signs of activity. If these fields contain zeroes or the other fields indicate errors:
    a. Reset the ATM module.
    b. Check the RFC-1483 Encapsulation configuration on the PowerCell module and on the other ATM hardware.
    c. Allow the PowerCell module to operate in the ATM network for a few moments.
    d. Refresh the RFC-1483 Encapsulation display.
    e. Test the PVC by pinging across the PVC from one endstation to another. The commands used to ping depend upon the type of workstation being used as the endstation.
    f. If the PowerCell module and ATM switch are properly configured but the RFC-1483 Encapsulation display still shows no packet activity or shows errors, contact FORE Systems TAC.

2.2.4 Removing an RFC-1483 Encapsulation from a Segment

Before another protocol on a segment can be configured for RFC-1483 Encapsulation, the current protocol must be disabled and removed from the segment. If this is not done, the segment is available to run any other protocol. To disable the segment, issue the **`sdisable`** command. Following is an example of the command. In this example, the terse form of the command is used.

```
10:PowerHub:atm/1483encap# sdisable 2.2
Okay
```

In the above example, RFC-1483 Encapsulation was disabled on segment 2.2. To verify that the command was successful, issue the **config show** command for that segment.

After disabling the segment, use the **atm sset protocol none** <*seglist*> command to remove the protocol from the segment. Following is an example of the command. In this example, the terse form of the command is used.

```
10:PowerHub:atm# sset proto none 2.2
Okay
```

In the above example, the RFC-1483 Encapsulation was removed from segment 2.2. To verify that the command was successful, issue the **config show** command. The segment is now available and can be configured for use by another protocol.

2.2.5 RFC-1483 Encapsulation Configuration Example

In Figure 2.2, the PVC configuration sets up PVCs from PowerHub "A" to PowerHub "B" through FORE ATM Switch "C" and a PVC from "B" to "A" through "C". Because PVCs are unidirectional, a PVC must also be set in the reverse direction, from PowerHub "B" to PowerHub "A" through FORE ATM Switch "C."

Note that each link between the PowerHub and the FORE ATM Switch is an independent PVC, and so the same VCI number can be used the full length of the connection as long as the FORE ATM Switch is configured to map the VCIs through the correct ports. In this example, different VCIs are used in each PVC to create the connections: VCI 191 is used for the PVC between PowerHub "A" and FORE ATM Switch "C", and VCI 192 is used for the PVC between FORE ATM Switch "C" and PowerHub "B". In the other direction, VCI 193 is used for the PVC between PowerHub "B" and FORE ATM Switch "C", and VCI 194 is used for the PVC between FORE ATM Switch "C" and PowerHub "A."

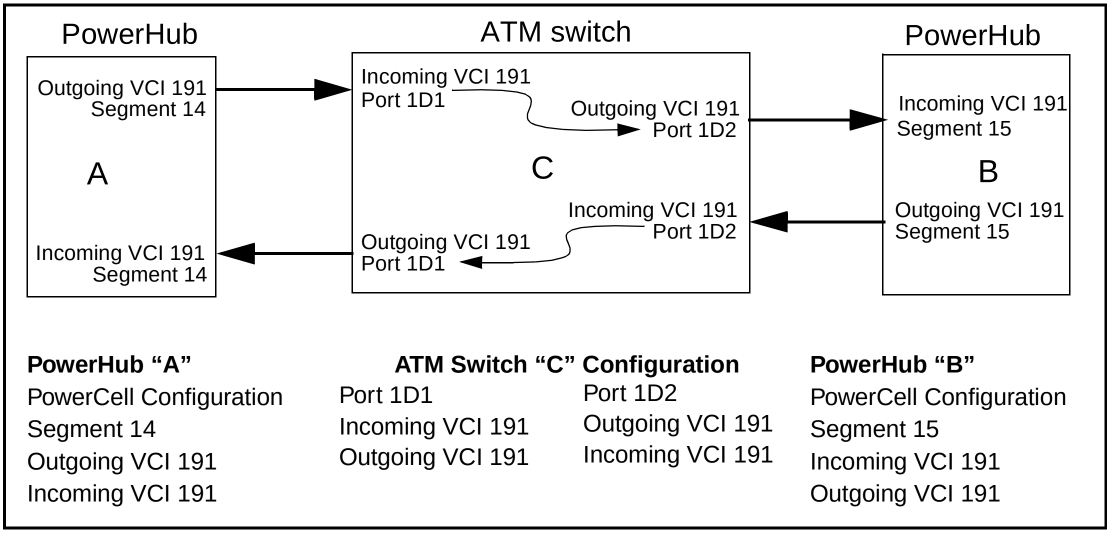

Figure 2.2 - Configuring PVCs from PowerHub "A" to PowerHub "B"

Note also that all commands must be issued from a management session on the PowerHub or switch being configured.

2.2.5.1 FORE ATM Switch "C"

Following is an example of the commands issued in the FORE ATM switch to configure the PVCs on the ATM switch to match the configuration shown above. The first command in this example configures the PVC from port 1D1 to port 1D2. The second command sets up the PVC in the reverse direction, from port 1D2 to port 1D1.

```
localhost::configuration> vcc new 1D1 0 191 1D2 0 192
localhost::configuration> vcc new 1D2 0 193 1D1 0 194
```

NOTE

Do not type the name of the subsystem with the command if already in the subsystem. The example below shows two ways to issue the same command. The first issues the command from within the vcc subsystem, the second from outside the vcc subsystem.

```
localhost::configuration vcc> new 1D1 0 191 1D2 0 192
localhost::configuration> vcc new 1D1 0 191 1D2 0 192
```

2.2.5.2 Assigning PVCs to a Virtual Segment

You can assign a PVC to a virtual segment by issuing the following commands:

inpvc sset *<vci> <seglist>*
outpvc sset *<vci> <seglist>*

sset Sets up the incoming or outgoing virtual channel ID on the specified segment.

<vci> Specifies the name of the incoming or outgoing PVC VCI.

<seglist> Specifies the segment you send or receive the PVC.

Following is an example of the **inpvc sset** command.

```
18:PowerHub:atm/1483encap# inpvc sset 100 1.4
```

Following is an example of the outpvc sset command.

```
18:PowerHub:atm/1483encap# outpvc sset 100 1.4
```

Following are the results produced by this command.

```
18:PowerHub:atm/1483encap# outpvc sset 100 1.4
RFC-1483 encapsulation information for port 1.4
    In PVC VCI:                     100
    Out PVC VCI:                    100
    Total Pkts sent:                25
    Total Pkts rcvd:                322
    Pkts rcvd with unknown type:    0
    Pkts rcvd with unknown protocol: 0
    Pkts rcvd with length too big:  0
```

The fields in this display show the following information:

In PVC VCI The incoming PVC's VCI.

Out PVC VCI The outgoing PVC's VCI.

Total Pkts sent The number of packets sent on this segment's outgoing PVC. The PowerCell module begins accumulating these statistics when RFC-1483 encapsulation on a segment is enabled.

Total Pkts rcvd The number of packets received on this segment's incoming PVC. The PowerCell module begins accumulating these statistics when RFC-1483 encapsulation on a segment is enabled.

Pkts rcvd with unknown type The number of packets received on this segment's incoming PVC with an unknown type. Any packet that does not contain a SNAP header and an OID of 0080c2 is considered a packet of unknown type.

Pkts rcvd with unknown protocol The PID which is not 0x0001, 0x0007, or 0x000e (STP).

Pkts rcvd with length too big The number of packets received on this segment's PVC with a packet length that is too big. Any packet that exceeds the maximum ethernet packet length of 1518 bytes is considered too big and is dropped.

2.2.5.3 PowerCell Module on PowerHub "A"

Following is an example of the PowerHub commands issued to configure the segment on the PowerCell module for RFC-1483 Encapsulation. The **atm sset protocol** command in the example configures PowerCell segment 1.4 on PowerHub "A" to use RFC-1483 Encapsulation.

```
13:PowerHub_A:atm# sset proto b 1.4
```

Before segment 1.4 can begin switching traffic between the ATM network and Ethernet and FDDI, the **atm sset protocol** command must be issued to enable RFC-1483 Encapsulation on the segment and configure the incoming and outgoing VCIs. Note that the incoming VCI number on the PowerCell segment must match the outgoing VCI number configured on the ATM switch. Likewise the outgoing VCI number on the PowerCell segment must match the incoming VCI number configured on the ATM switch.

```
14:PowerHub_A:atm# sset proto b 1.4
```

After configuring the VCIs and enabling the segment for RFC-1483 Encapsulation, verify the configuration and display packet statistics using the **atm/1483encap config show** command, as shown in the following example.

```
15:PowerHub_A:atm/1483encap# config show 1.4
RFC-1483 encapsulation information for segment 1.4
    In PVC VCI:                      194
    Out PVC VCI:                     191
Total Pkts sent:                 25
    Total Pkts rcvd:                 322
    Pkts rcvd with unknown type:     0
    Pkts rcvd with unknown protocol: 0
    Pkts rcvd with length too big:   0
```

2.2.5.4 PowerCell Module on PowerHub "B"

Repeat the process used to configure PowerHub "A" for the PowerCell Module in PowerHub "B". Use the same commands and use the VCI numbers that match the port numbers configured on the ATM switch that are connected to PowerHub "B". For the example the command would be as follows:

```
13:PowerHub_B:atm# sset proto b 1.5
```

Then issue the **atm sset protocol** command to enable RFC-1483 Encapsulation on the segment and configure the VCIs. Note that the incoming VCI number on the PowerCell segment must match the outgoing VCI number configured on the ATM switch. Likewise the outgoing VCI number on the PowerCell segment must match the incoming VCI number configured on the ATM switch.

```
14:PowerHub_B:atm# sset proto b 1.5
```

After configuring the VCIs and enabling the segment for RFC-1483 Encapsulation, verify the configuration and display packet statistics using the **config show** command, as shown in the following example.

```
15:PowerHub_B:atm# config show 1.5
RFC-1483 encapsulation information for segment 2.1
    In PVC VCI:                      192
    Out PVC VCI:                     193
Total Pkts sent:                 34
    Total Pkts rcvd:                 652
    Pkts rcvd with unknown type:     0
    Pkts rcvd with unknown protocol: 0
    Pkts rcvd with length too big:   0
```

2.2.5.5 Selecting VCIs

In Figure 2.3, two different VCIs were used for the individual PVCs in each unidirectional connection between the two PowerHubs. However, the same VCI number can be used along the length of a connection if these VCIs are not being used by other VCCs. Using the same VCI for the length of a connection simplifies configuration and management of VCIs, PVCs, and connections. VCI 191 is used for both PVCs from PowerHub "A" to PowerHub "B", and VCI 192 is used for both PVCs from PowerHub "B" back to PowerHub "A".

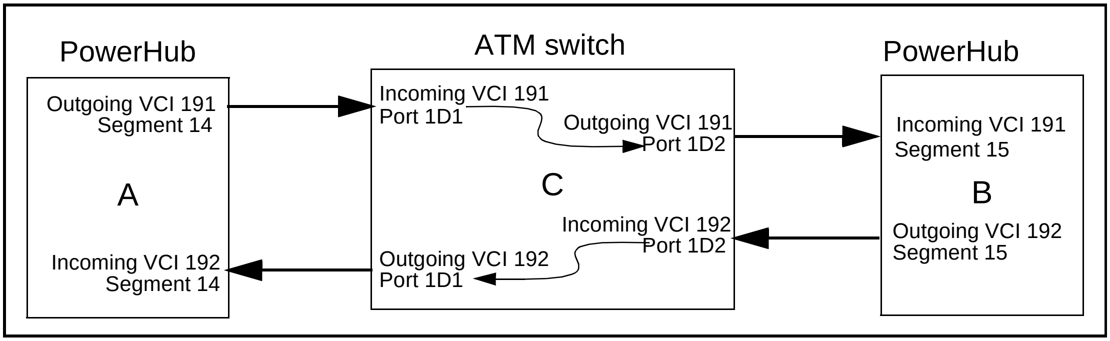

Figure 2.3 - Selecting VCIs

2.2.6 Spanning-Tree on Bridged 1483

The Spanning-Tree algorithm is a mechanism that logically eliminates physical loops in a bridged 1483 network. For example, PVCs are configured on two different segments through a switch from one PowerCell to another PowerCell, forwarded traffic on one segment loops back to the second segment. When this happens, the network has a loop.

Unless the network topology is reconfigured or the bridges to break the loop, or implement a mechanism to logically break the loop, packets are forwarded from bridge to bridge indefinitely, clogging the network. Whenever a segment's state is changed, either by automatic segment-state detection or by a user-interface command, the Spanning-Tree algorithm adjusts the network topology accordingly.

To stop a loop in a 1483 bridged network, enable the Spanning-Tree algorithm using the **`spantree`** command in the `bridge` subsystem. For more information on how to enable the Spanning-Tree algorithm, refer to the *PowerHub Software Reference Manual.*

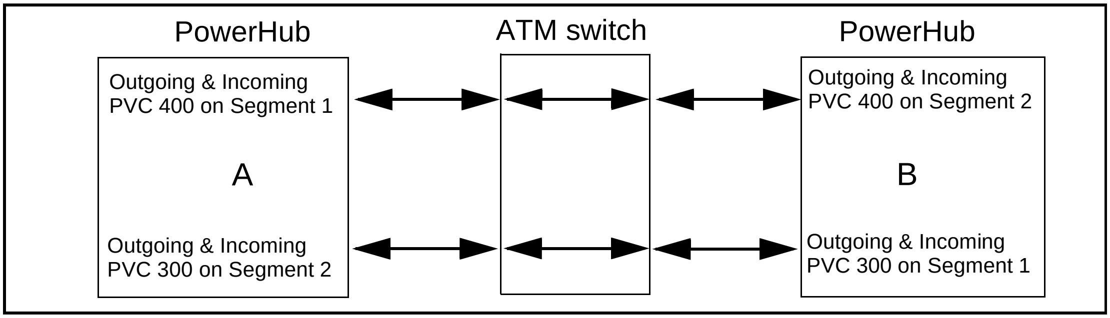

Figure 2.4 - Example of a Bridged 1483 Network

Figure 2.4 shows a bridged 1483 network. Segment 1 on PowerHub A is configured with PVC 400 to segment 2 on PowerHub B. Segment 2 on PowerHub A is configured with PVC 300 to segment 1 on PowerHub B. After enabling the Spanning-Tree algorithm in the Bridge subsystem with the **spantree** command, use the **senable** command in 1483encap to turn on Spanning-Tree for bridged PVCs. The first PVC segment configured is set to a forwarded state for traffic, while the second PVC segment is set to a blocking state eliminating any loopback of packets.

CHAPTER 3 Routed 1483 over ATM

This chapter describes the PowerHub support for Routed 1483 over ATM. Routed 1483 (RFC 1483) that allows transmission of IP datagrams and ARP requests and replies over ATM using ATM Adaptation Layer 5 (AAL5).

NOTE

Routed 1483, unlike Bridged 1483, supports multiple PVCs per virtual interface. Bridged 1483 allows only one PVC. In addition, Routed 1483 performs IP to PVC mapping statically. It does not support Signalling or ARPing of packets.

Normally, ATM connections in a Routed 1483 environment are established dynamically using UNI 3.0. ARP, ILMI and UNI 3.0 all working together as when setting up an SVC. If a host or switch in an LIS does not support UNI 3.0, however, it is not possible to establish an SVC. In this case, a Routed 1483 PVC can be used for communication.

On each of the Routed 1483 PowerHub segments the **`sset`** command is used to establish the PVC. An unused VCI must be chosen for each Routed 1483 PowerHub segment. PVCs using the chosen VCI must also be setup from each of the hosts to the connecting switch, and then on all of the switches between the two connecting switches.

NOTE

Both the incoming and outgoing connections are set up simultaneously on the host, but they must be set up individually on the switches. The same VCI is used by a host to send on the PVC as well as receive on the PVC. The IP datagrams are sent over the PVC using AAL5 with LLC/SNAP encapsulation.

3.1 The PowerCell Module and Routed 1483

Routed 1483 networks contain the following components:

Logical IP Subnet (LIS) A group of IP hosts or routers that are directly attached to an ATM switch and have the same IP network address, subnet address, and subnet mask. One LIS can be configured on each PowerCell segment used for Routed 1483. Individual members of the LIS are joined directly to other members using configured PVCs. Hosts that are not members of the LIS can be reached only by using a LAN router (such as the PowerHub 7000).

The virtual interfaces that are created in Routed 1483 are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, when destined for any other interfaces on the PowerHub, including another LIS on the same PowerCell module.

Figure 3.1 shows an example of an ATM network using Routed 1483. Notice that each ATM host is a member of an LIS. In this example, the hosts are grouped into two LISs: 147.128.10.x with PVCs 100-104 on segment 1 and 147.128.20.x with PVCs 201-205 on segment 2. The subnet mask used in the following example is 255.255.255.0.

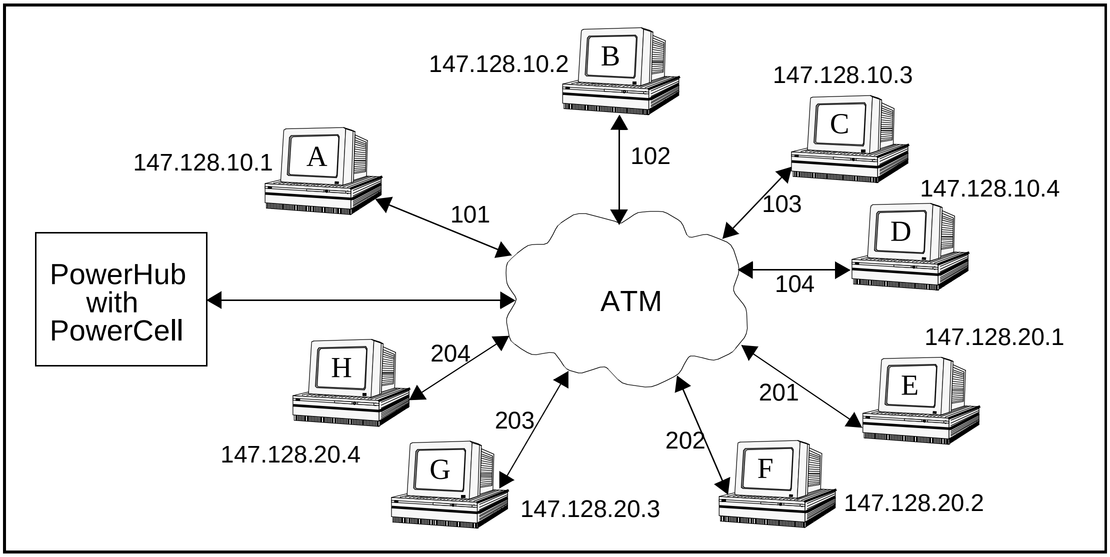

Figure 3.1 - Routed 1483 Network

Figure 3.2 shows stations H, G, F, and E connected to segment 2 using Routed 1483. Configure a PVC to each of these hosts with its associated IP address.

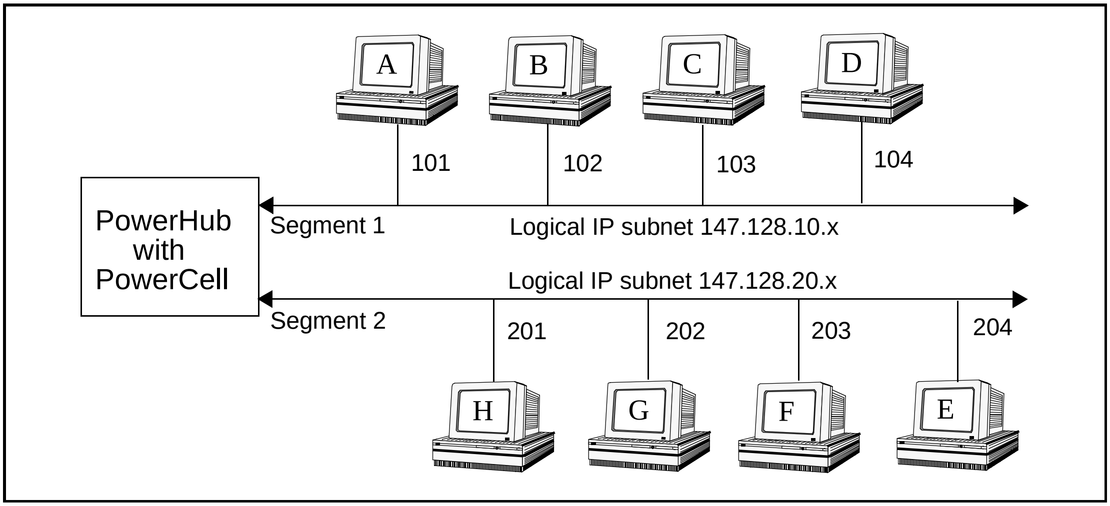

Figure 3.2 - Routed 1483 Network Containing LISs

Figure 3.1 and Figure 3.2 show two LISs connected to a PowerCell module, which is installed in a PowerHub. Without a router to connect the LISs, the members of LISs cannot communicate with each other. The PowerCell module enables the LISs to communicate by routing IP traffic between the LISs. From the PowerHub in Figure 3.2, segment 1 connects with PVC 101 to station A, PVC 102 to station B, and so on, with logical IP subnet 147.128.10x.

3.1.1 Routed 1483 PVC Support and Packet Encapsulation

The PowerCell module can establish connections between members of an LIS using PVCs. After the PowerCell software establishes a PVC, the software encapsulates IP packets using IEEE 802.2 LLC/SNAP encapsulation, and segments the packets into ATM cells using AAL5.

The default MTU is 9,180 bytes. When the SNAP header is added, the size becomes 9,188 bytes. The maximum packet size is 9180. The same (MTU) size is used for all VCs in a LIS.

3.1.2 ATM ARP Support

To configure a PowerCell segment to use Routed 1483 specify the VC. (This task is performed using the **routed1483 sset** command. See Section 3.2.2.) When a PowerCell segment is configured to support Routed 1483, the segment must be IP configured. Routing must be enabled.

3.1.2.1 Routed 1483 ARP Display

To display configured IP-PVC pairs for the Routed 1483 segments, use the **arp show** command.

arp show *<seglist>***|all**

show	Displays the cache entries established.
<seglist>|all	Displays the cache entries established on the specified segment.

The following are the results produced by this command.

```
117:PowerHub:atm/1483routed# arp show all
Configured PVCs and state:
IP Address      PVC    Segment    State
------------    ---    -------    -----
147.128.10.1    300      1.1      VALID
```

IP Address	Indicates the configured destination IP address.
PVC	Indicates the configured PVC.
Segment	Displays the segment configured for PVC.
State	The state always remains “VALID” in Routed 1483.

The following example shows PowerCell segment 5.2 configured for PVC with an IP address of 1000.1.1.2. The state of the PVC is “VALID”.

```
117:PowerHub:atm/1483routed# arp show all
Configured PVCs and state:
IP Address      PVC    Segment    State
------------    ---    -------    -----
100.1.1.3       200      5.2      VALID
```

3.1.3 MTU Size

The default MTU size for IP members operating over the Routed 1483 ATM network is 9180 octets. The LLC/SNAP header is 8 octets, therefore the default Routed 1483 ATM AAL5 protocol data unit size is 9188 octets. In Routed 1483 subnets, values other than the default can be used if and only if all members in the LIS have been configured to use the non-default value.

If a Routed 1483 packet is locally forwarded by the PowerCell module from one LIS to another LIS attached to the same module, the packet is forwarded without being fragmented. However, if the PowerCell module sends the packet to the Packet Engine for processing (for example, if the packet is destined for a segment on another module in the PowerHub), the module fragments the packet before sending it to the Packet Engine. The fragments can be a maximum of 4060 bytes long. The fragment sizes depend upon the destination medium (ATM, FDDI, or Ethernet).

3.2 Configuring a PowerCell Segment for Routed 1483

To use a PowerCell segment for Routed 1483 routing in an ATM network, perform the following configuration tasks for each segment:

- Configure an IP interface on the segment (if not already done so). (Use the **`ip interface add`** command.)
- Set the ATM protocol type to Routed 1483. (Use the **`atm sset protocol`** command.)
- Enable IP routing.
- Specify the PVC and the IP address.

The following sections describe how to perform these tasks.

3.2.1 Configuration Considerations

Before configuring the PowerCell module for Routed 1483, make sure the configuration plans are not affected by the following considerations:

- Only one IP interface can be configured on a PowerCell segment enabled for Routed 1483.
- Broadcast traffic is not supported, as there is no mechanism in place to distribute broadcast packets. If the segments to be configured require the ability to send and receive broadcast traffic, use LANE 1.0 on the segments.
- Only one IP interface can be configured on a PowerCell segment, for a maximum of 32 IP interfaces on a PowerCell module.
- Layer-3 VLANs are not supported on PowerCell segments configured for Routed 1483. To configure a Layer-3 VLAN on multiple PowerCell segments, use LANE 1.0 on the segments.
- Do not include the segments that were configured for Routed 1483 in PowerHub bridge (network) groups.

3.2.2 Configuring a Segment for Routed 1483 on ATM

Before enabling Routed 1483 on a segment, configure the PowerCell segment to use Routed 1483 using the **`atm sset protocol`** command. To configure the PowerCell segment to use Routed 1483, telnet into or connect to the PowerHub through the TTY interface, change to the **atm** subsystem, and configure the desired segment using the following command:

`sset proto[col]` *<proto>* **`<seglist>|all`**

<proto> Specifies the protocol to be used on a segment. To configure the PowerCell segment to use Routed 1483 issue the following:

`r1483[routed-1483]`

<segment-list>|all Specifies the PowerCell segment being configured. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If **`all`** is specified, all segments on all the PowerCell modules are configured to use the Routed 1483 protocol.

After configuring a PowerCell segment to use Routed 1483:

- Specify the PVC and IP address to be used on the segment. (Do this before enabling Routed 1483 on the segment.)
- Enable Routed 1483 on the segment.

To perform these tasks, use the **`sset pvc`** and **`senable`** commands. The syntax for this command is:

`sset` *`<pvc> <destination-ip-address> <seglist>`*

<pvc> Specifies the PVC to be used on the segment. Valid PVCs range between 32 and 1023.

<destination-ip-address> Specifies the destination IP address of the PVC.

<seglist> Specifies the PowerCell segment being configured.

Following are some examples of the **`sset pvc`** and **`senable`** commands. The first command in this example sets the PVC on segment 5.2 and a revalidation time of 20 minutes. The second command ignores the revalidation interval by defaulting to 15 minutes.

```
10:PowerHub:atm/1483routed# sset 300 5.2
Okay
11:PowerHub:atm/1483routed# senable 5.2
Segment 5.2 enabled
```

3.2.3 Removing Routed 1483 from a Segment

To remove Routed 1483 from a segment, perform the following steps:

1. Disable the segment using the **`sdisable`** command (The **`sdisable`** command is described in Section 3.2.2).
2. Remove one or more configured PVCs from a segment, using the **`pdelete`** command. The **`pdelete`** command is used to delete a single PVCs or all of the PVCs from a Routed 1483 segment.
3. Undefine the protocol using the **`atm proto sset None`** command.

The following example shows how to perform these steps:

```
10:PowerHub:atm/1483routed# sdisable all
Okay
11:PowerHub:atm/1483routed# pdelete all
Okay
12:PowerHub:atm# proto sset None all
Okay
```

3.2.3.1 For Members of an LIS

The requirements for IP members (hosts, routers) operating in an ATM LIS configuration are as follows:

- All members have the same IP network number, subnet number, and subnet mask.
- All members within the LIS must be directly connected to the ATM network. Members outside of the LIS can be accessed only by a router (such as the PowerHub).
- All members within the LIS must be able to communicate through ATM with all other members of the same LIS. That is, the VC topology underlying the interconnection among the members must have the ability to be fully meshed.

3.3 Displaying the Routed 1483 Configuration

The current Routed 1483 configuration can be displayed using the **config [show]** command. Following is an example of the display produced by this command:

```
117:PowerHub:atm/1483routed# config show all
Configured PVCs and state:
PVC    IP Address     State     Segment
---    ----------     -----     -------
300    100.1.1.2       enl      1.1
```

PVC Specifies the PVC associated with the segment.

State Indicates whether Routed 1483 is enabled or disabled on this segment.

Segment Shows the segment running Routed 1483.

3.3.1 Displaying and Clearing Statistics

The current Routed 1483 statistics can be displayed using the **stats [show]** command. Following is an example of the display produced by this command:

```
117:PowerHub:atm/1483routed# stats show 1.1
Displaying statistics from the ATM Card for segment 1.1
Routed-1483-Over-ATM Statistics for segment 1.1
--------------------------------------------
Connection Fails:                  0
Total Control Packets In:          0
Total Control Packets Out:         0
Arp Replies In:                    0
Arp Replies Out:                   0
Total Arp Replies :                0
Arp Requests In:                   0
Arp Requests Out:                  0
Deleted Arp Replies:               0
Unknown Arp Replies:               0
Total InARP Requests:              0
Total ARP NAKs:                    0
Total bad ARP operations:          0
Total times 1483routed restarted: 1
Unknown Packets received:          0
Unicast Data in:                   17554
Bad ip packets in:                 0
Unicast Packets dropped:           1
Unicast packets forwarded:         17553
```

Use the **stats clear** command to clear Routed 1483 over ATM statistics. All learned entries are removed, but static entries (created using the **sset atmarp** command) remain in the table. These must be removed manually using the **pdelete** command.

This command can be used to help restabilize the network after a host is moved from one segment to another. When there is activity on the network, the cleared entries quickly reappear in the ATM ARP table, and a host that has been moved will be relearned on its new segment.

A Routed 1483 segment is removed on the host side using **`pdelete`** command after disabling the PVC segment using the **`sdisable`** command. Both incoming and outgoing connections are removed simultaneously. The PVC must then be removed from each of the network switches involved.

CHAPTER 4 LANE LEC Configuration

The PowerHub supports the ATM Forum's Local Area Network Emulation (LANE) 1.0 and User-Network Interface (UNI) 3.0 protocol standards. The ATM standards can be used to associate a logical segment on the PowerHub with an Emulated LAN (ELAN). An ELAN is a group of ATM stations that appear to the PowerHub as an Ethernet segment (broadcast domain). From the PowerHub perspective, ATM stations grouped into an ELAN appear to be nodes on a single Ethernet segment. Each PowerHub segment can be associated with a separate ELAN.

LANE 1.0 places Ethernet and FDDI LANs on top of an ATM network. The PowerCell module can be used to overlay the Ethernet, Fast Ethernet, and FDDI networks managed by the PowerHub onto ATM. Each logical segment on the PowerCell module can be associated with an ELAN attached to the PowerCell module.

4.1 Ethernet LAN Characteristics Emulated by 1.0

LANE 1.0 emulates the following characteristics of Ethernet LANs:

Connectionless service LANE establishes virtual circuits (VCs) to bridge traffic between an Ethernet LAN and ATM, but the VCs are transparent to the Ethernet LAN equipment.

Broadcast and multicast service The Broadcast and Unknown Server (BUS) is a component of LANE that emulates broadcast and multicast services. When the PowerCell module needs to forward broadcast or multicast traffic from an Ethernet network, the module sends the traffic to the BUS, which in turn sends the traffic to each of the destination nodes in the ELAN.

Figure 4.1 shows an example of an ATM network using LANE 1.0. Notice that each ATM station is a member of an ELAN. In Figure 4.1, the stations are grouped into two ELANs: ELAN1 and ELAN2.

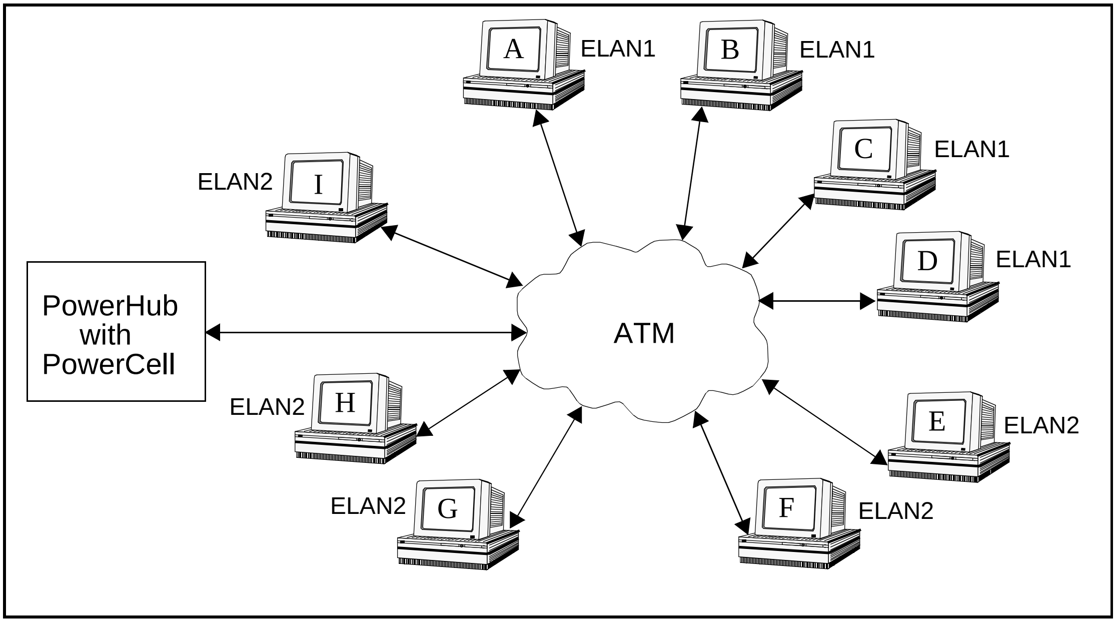

Figure 4.1 - ELANs on the ATM network.

Figure 4.1 shows the same ATM LANE 1.0 network from the PowerHub's perspective. Notice that the ATM stations are still grouped into the same ELANs. However, the PowerHub regards each ELAN as an independent Ethernet segment. Figure 4.2 shows ATM LANE 1.0 network containing ELANs—PowerHub view.

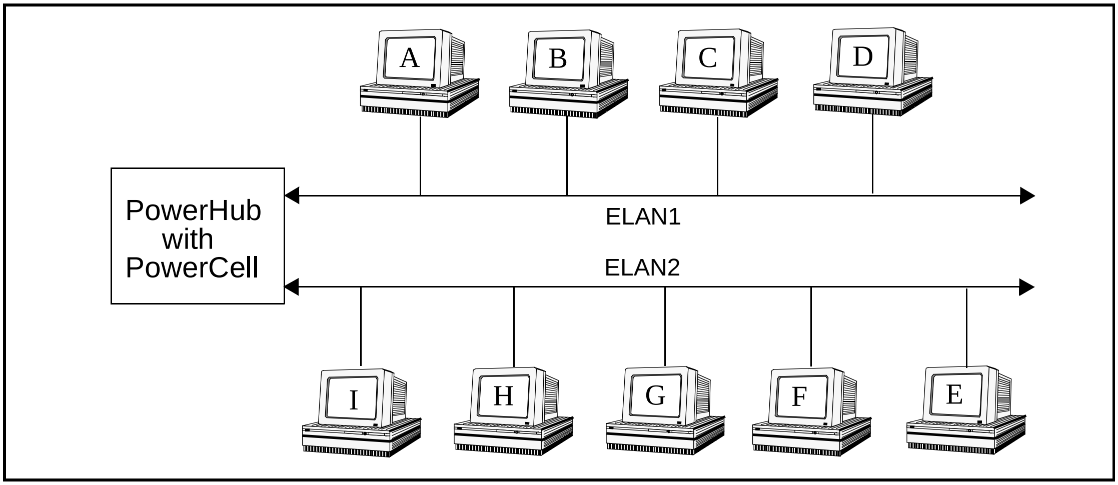

Figure 4.2 - PowerHub view of ELANs on the ATM LANE network.

Because ATM stations grouped in an ELAN appear to the PowerHub as members of a single Ethernet segment, all the configuration features and management features available on the PowerHub for Ethernet segments also are available for ELANs. The features include 802.1d bridging, the Spanning-Tree algorithm, IP, IPX, AppleTalk, and DECnet routing protocols, and ARP, as well as automatic segment-state detection, bridge groups, and VLANs.

4.2 The PowerCell Module and LANE 1.0

The following sections describe the LANE 1.0 components and the role the PowerCell module plays in a LANE 1.0 network.

4.2.1 LANE 1.0 Components

LANE 1.0 networks contain four major components:

LAN Emulation Client (LEC) The LEC is the component in an end system that performs data forwarding, address resolution, and other functions when communicating with other components of an ELAN. A PowerCell segment can be configured as a LEC.

When the PowerCell segment is enabled as a LEC, the PowerCell software performs data forwarding, address resolution, and other control functions when communicating with other components of an ELAN.

LAN Emulation Configuration Server (LECS)

The LECS is responsible for the initial configuration of a LEC. The LECS provides the LEC information about the ELANs that the LEC can join. The LECS also provides the LEC the address of the LES (see below) associated with each ELAN.

The LECS on an ATM host can be configured such as a UNIX workstation, or on a FORE Systems ATM switch.

LAN Emulation Server (LES)

The LES is an LAN Emulation ARP (LE_ARP) server and contains address resolution information for an ELAN. The LES contains a table that maps the MAC address of each device in the ELAN to its corresponding ATM address.

The LES can be configured on the ATM switch or on the PowerCell 700.

Broadcast and Unknown Server (BUS)

The BUS emulates the multicast and broadcast functions of an Ethernet segment. When the LEC needs to send a broadcast or multicast packet, or does not know the destination of a unicast packet, the LEC sends the packet to the BUS. The BUS then floods the packet to the appropriate end systems. The BUS can be configured on the ATM switch or on the PowerCell 700.

4.2.2 Advantage of Using a PowerCell Module with LANE 1.0

Figure 4.3 shows an example of an ATM switch connected to multiple LANE 1.0 ELANs. In this configuration, the ATM switch cannot directly bridge or route traffic from one ELAN to another.

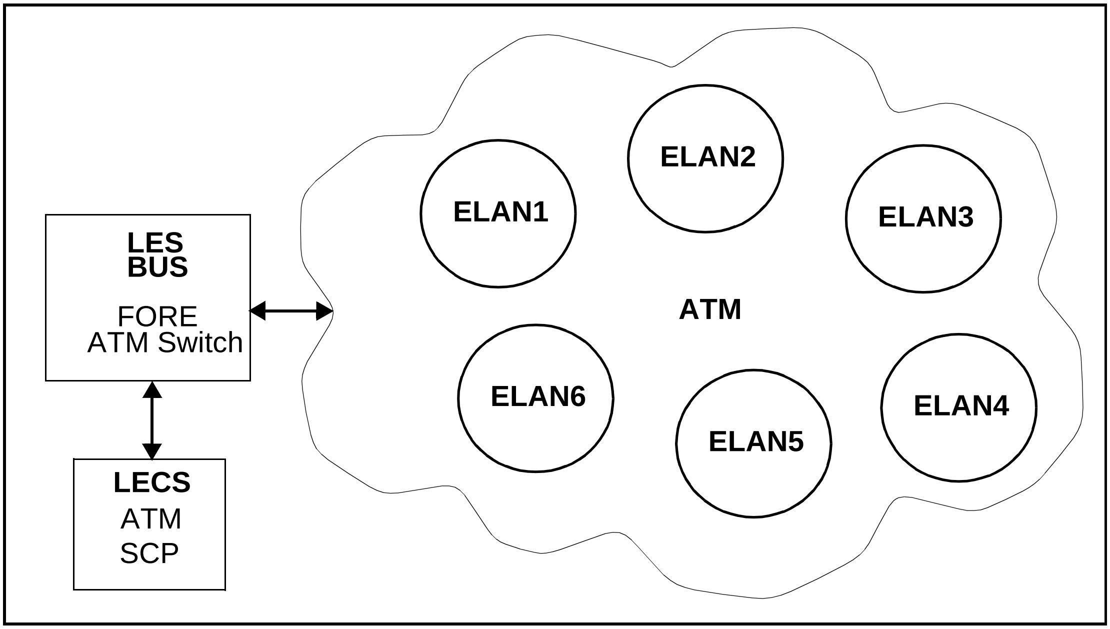

Figure 4.3 - ELANs Configured on the Switch

In Figure 4.3, the ATM switch is switching traffic between LECs on an ELAN. However, the ATM switch cannot bridge or route from one ELAN to another without a PowerHub. For example, traffic from ELAN1 cannot be bridged or routed to ELAN2. Figure 4.4 shows how by adding the PowerCell module to the ATM network enables bridging and routing among LANE 1.0 ELANs.

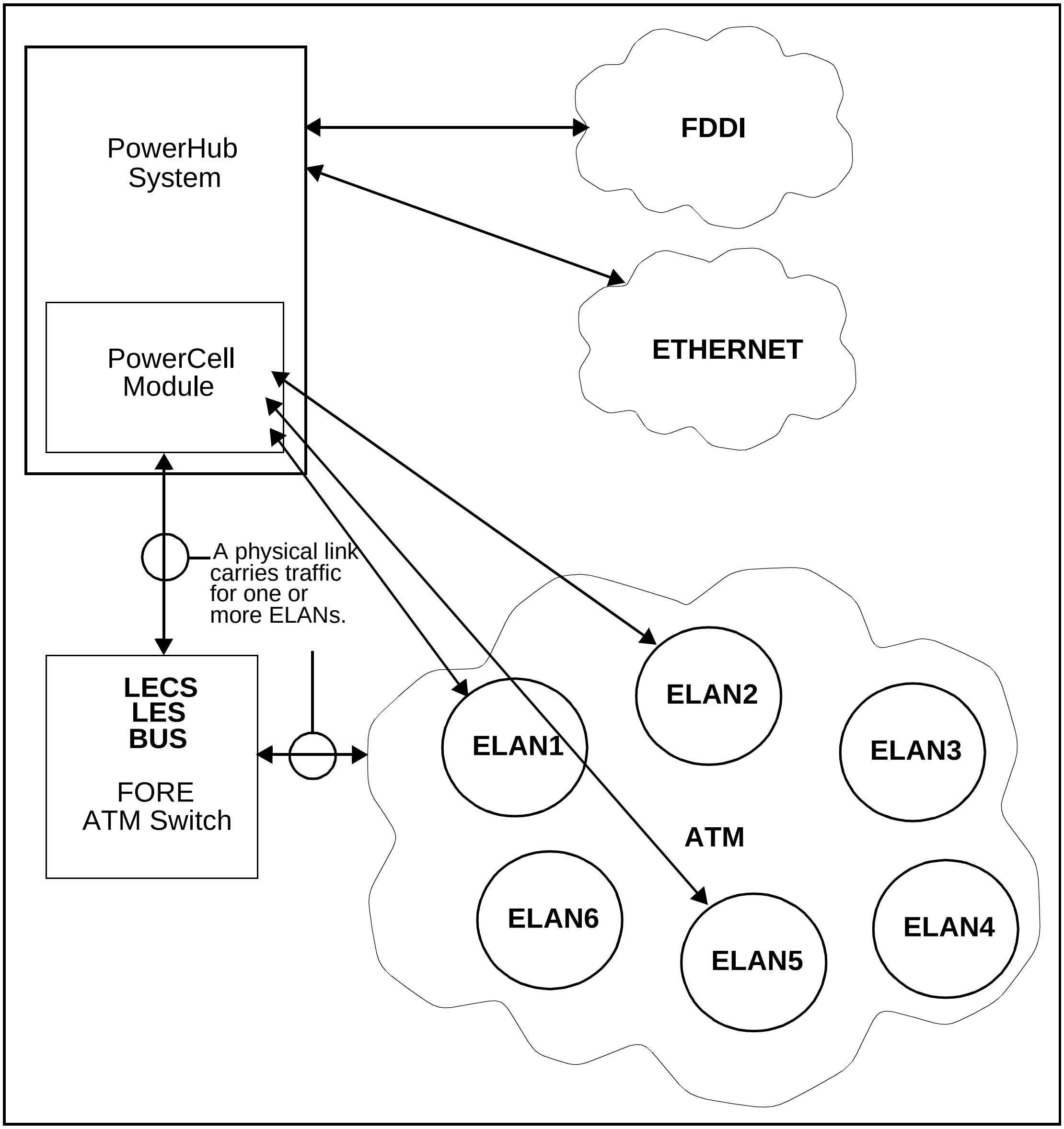

Figure 4.4 - Bridging and Routing Among LANE 1.0 ELANs

As shown in Figure 4.4, a PowerCell module has been added to the ATM network. LANE 1.0 traffic from one ELAN to another is sent by the ATM switch to the PowerCell, which uses its on-board ATM processing software to forward the traffic to the appropriate ELAN. For example, traffic sent from ELAN1 to ELAN2 is received by the ATM switch, which sends the traffic to the PowerCell module. The PowerCell module receives the LANE 1.0 packets, removes the LANE 1.0 headers, then examines the destination and source addresses of the packet for forwarding information.

Traffic sent from the PowerHub's Ethernet or FDDI segments to devices in an ELAN are translated by the PowerCell module from Ethernet packets into ATM cells, then sent to the ELAN.[1] Traffic sent by an ELAN to an Ethernet or FDDI segment is translated by the PowerCell module into Ethernet or FDDI packets, then sent to the appropriate PowerHub segments.

4.3 Local LES and BUS

In software version PH_FT4.0.0 and later, the LES and BUS can be configured on the PowerCell 700 itself. A LES or BUS configured on the PowerCell 700 is called a local LES or local BUS. Depending on configuration needs, the LES and BUS can both be configured on the PowerCell 700 or just one or the other. If both the LES and the BUS are configured on the PowerCell module, the LES and BUS are called colocated.

A colocated LES and BUS share address resolution information. Therefore, by colocating the LES and BUS, the forwarding of unknown packets provided by the LES and BUS is optimized. To configure a LES or BUS or a colocated LES and BUS on the PowerCell 700, use the procedure in Section 4.4.3.

1. The ATM LANE 1.0 specification does not deal with translating FDDI packets directly into ATM. The PowerHub system can translate traffic between FDDI and ATM while still adhering to the ATM LANE 1.0 standards because the PowerHub system changes FDDI packets into Ethernet packets internally before translating them into ATM cells.

4.4 Configuring for LANE 1.0

To use the PowerCell module for bridging and routing in a LANE 1.0 ATM network, perform the following configuration tasks:

- Prepare the ATM hardware for LANE 1.0. For more information on preparing the ATM hardware, see the *PowerHub Hardware Reference Manual*.
- Add ELANs to the segments allocated to the PowerCell module. The ELAN names assigned to a segment must match the ELAN names specified when configuring the LECS on the ATM switch. (Use the **elan add** command.)
- The **elan add** command enables the LEC automatically. Specify the LECS address with either the **elan add** or the **lecs cset** command. By default, the PowerCell module uses LECS Well Known Address (If the LECS is not used to get configuration information, the LES address must be specified when adding an ELAN to the LEC.).

4.4.1 Configuring Other ATM Hardware for LANE 1.0

The following sections describe how to configure ATM hardware for LANE 1.0.

4.4.1.1 LES and BUS

If using a PowerCell segment as a LEC for LANE 1.0, the following items must be defined within the ATM network:

- LAN Emulation Server (LES).
- Broadcast and Unknown Server (BUS).

Configure the LES and BUS on the ATM switch, on a UNIX workstation configured with an SBA-200 Adapter Card, *ForeRunner* ASN-9000, or on the PowerCell 700.

The following sections describe how to configure the ASX ATM Switch, an SBA-200 Adapter Card, and a PowerCell 700. Each procedure contains steps for configuring the LES and BUS. Configure the LES and BUS on only one device for each ELAN supported by the devices.

- To configure the LES and BUS on the PowerCell 700, see Section 4.4.3.

4.4.1.2 LECS

In addition to the LES and BUS (which are required), the LECS can optionally be configured. The LECS supplies the LES address to the LEC (PowerCell module). If a LECS is not configured, the LES address must be specified manually when adding an ELAN to the PowerCell module. Note that the LECS cannot be created on the PowerHub. It must be located on the ATM Switch or a host with an SBA ATM adapter card.

The following sections contain configuration instructions for bringing up LANE 1.0 services on the SBA-200 Adapter Card and the FORE ATM switch.

4.4.2 Configuring the PowerCell Module for LANE 1.0

The following sections describe the commands used to configure the PowerCell module for LANE 1.0. The commands used to configure the PowerCell for LANE 1.0 are located in the `atm/lane` subsystem.

4.4.3 Configuring the LES and BUS on the PowerCell 700

Using the commands described in the following sections, the LES, the BUS, or a colocated LES/BUS pair can be configured on a PowerCell 700. In addition to the commands described in the following sections, the PowerCell software contains commands for displaying LES and BUS statistics and deleting a LES or BUS. See Section 4.4.3.6.

4.4.3.1 Configuring a Colocated LES and BUS

To configure a colocated LES and BUS on the PowerCell 700, issue the following command:

les add *<les-elan-name> <slot> <les-SELbyte>* *<bus-SELbyte|bus-atm-address>* [[rg=]*<rate-group>*] [-type](ethernet|token-ring) [-mtu(1516|4544|9234)]

<les-elan-name> The ELAN that the LES, BUS, or LES/BUS pair being created serve. Specify an alphanumeric name from 1 to 32 characters in length.

<slot> The slot that contains the PowerCell 700. Slots are labeled on the chassis. Slot numbers can also be determined by using the **system config show** command.

<les-SELbyte> The Selector byte of the LES. The Selector byte is the final two hexadecimal digits in an NSAP ATM address. Specify the hexadecimal digits alone or use “0x” to flag them. In either case, the software assumes that the digits are hexadecimal.

<bus-SELbyte|bus-atm-address> The Selector byte of the BUS or address. Specify the hexadecimal digits alone or use “0x” to flag them. In either case, the software assumes that the digits are hexadecimal.

NOTE To create a colocated LES/BUS, do not specify the full ATM address of the BUS.

<rate-group> Specifies the maximum amount of traffic that can be transmitted over the ATM segments to which the rate group is assigned. The default is 1 group with 155 mbps. You can define up to 16 rate groups.

[-type](ethernet|tokenring) Specifies the type of encapsulation in use by the LES.

[-mtu(1516|4544|9234)] Specifies the maximum size of the MTU (Maximum Transmission Unit).

Following is an example of this command. In this example, a colocated LES/BUS is added to the PowerCell 700 in slot 1.1. Because only the Selector byte of the BUS is specified, the PowerCell software assumes a colocated LES/BUS and creates one. The LES/BUS serves the ELAN named “engineering.”

```
4:PowerHub:atm/lane# les add engineering 1.1 0x10 0x20
```

4.4.3.2 Configuring an Independent NSAP LES

To configure an independent NSAP LES on the PowerCell 700, issue the following command:

```
les add <les-elan-name> <slot> <Service-ID>
[[rg=]<rate-group>] [-type](ethernet|token-ring)
[-mtu(1516|4544|9234)]
```

<les-elan-name> The ELAN that the LES, BUS, or LES/BUS pair being created serves. Specify an alphanumeric name from 1 to 32 characters in length.

<slot> The slot that contains the PowerCell 700. Slots are labeled on the chassis. Slot numbers can also be determined by using the **system config show** command.

<Service-ID> Specifies the 8-digit Service Identifier (decimal notation or prefix with a "0x" for hex. notation). This ID is used to construct an ATM address where the service can be located independent of the physical topology. Both the LES and BUS are created under this usage.

[rg=]<rate-group>	Specifies the maximum amount of traffic that can be transmitted over the ATM segments to which the rate group is assigned. The default is 1 group with 155 mbps. Up to 16 rate groups can be defined.
[-type](ethernet|token-ring)	Specifies the type of encapsulation in use by the LES.
[-mtu(1516|4544|9234)]	Specifies the maximum size of the MTU.

In the following example, a LES for an ELAN called “marketing” is added to the PowerCell 700 in slot 2. The Selector byte of the LES is 30 (hexadecimal). Because the BUS is on another device, the full ATM address of the BUS is specified. By specifying the ATM address of the BUS, the LES is informed of the location of the BUS in the ATM network.

```
4:PowerHub:atm/lane# les add marketing 2 0x30
47:0005:80ff:e100:0000:f21a:2c00:0000ef042990:20
```

4.4.3.3 Deleting a Configured LES

To delete a LES configured on the PowerCell 700, issue the following command:

les delete ***<les-elan-name> <slot>***

<les-elan-name>	The name of the ELAN that the LES serves.
<slot>T	The slot that contains the PowerCell 700. Slots are labeled on the chassis.

4.4.3.4 Configuring a BUS

To configure a BUS (but not a colocated LES/BUS) on the PowerCell 700, issue the following command:

bus add ***<bus-elan-name> <slot> <bus-SELbyte>***
[[rg=]*<rate-group>*] [-type](ethernet|token-ring)
[-mtu(1516|4544|9234)]

<bus-elan-name>	The name of the ELAN that the BUS serves. Specify an alphanumeric name from 1 to 32 characters in length.
<slot>	The slot that contains the PowerCell 700. Slots are labeled on the chassis. Slot numbers can also be determined by using the **system config show** command.

<bus-SELbyte>	The Selector byte of the BUS. The Selector byte is the final two hexadecimal digits in an NSAP ATM address. Specify the hexadecimal digits alone or use “0x” to flag them. In either case, the software assumes that the digits are hexadecimal.
[rg=]<rate-group>	Specifies the maximum amount of traffic that can be transmitted over the ATM segments to which the rate group is assigned. The default is 1 group with 155 mbps. Up to 16 rate groups can be defined.
[-type](ethernet|token-ring)	Specifies the type of encapsulation in use by the LES.
[-mtu(1516|4544|9234)]	Specifies the maximum size of the MTU.

Following is an example of this command. In this example, a BUS is added to the PowerCell 700 in slot 1 for an ELAN named “MAGIC-BUS.” The Selector byte for the BUS is 20 (hexadecimal). In this example, the “0x” used to denote a hexadecimal address is omitted. The “0x” is optional.

```
4:PowerHub:atm/lane# bus add MAGIC-BUS 1 20
```

4.4.3.5 Deleting a BUS

To delete a configured BUS, issue the following command:

bus delete ***<bus-elan-name>*****|all** ***<slot>***

<bus-elan-name>|all	Name of the ELAN that the BUS serves.
<slot>	Slot that contains the PowerCell 700. Slots are labeled on the chassis.

4.4.3.6 Displaying the LES and BUS Configuration

After a LES, BUS, or a colocated LES/BUS are configured on the PowerCell 700, display the configuration by issuing the following command:

les [show] ***<service-name>*****|all** ***<slot>*****|all**
bus [show] ***<service-name>*****|all** ***<slot>*****|all**

<service-name>|all	The name of the ELAN that the LES, BUS, or LES/BUS pair serves. If **all** is specified, configuration information about all LESs, BUSs, and colocated LES/BUSs on the PowerCell 700 in the specified slot is displayed.

<slot>|all The slot that contains the PowerCell 700. Slots are labeled on the chassis. Slot numbers can also be determined by using the **system config show** command. If **all** is specified, configuration information about all LESs, BUSs, and colocated LES/BUSs on all PowerCell 700 Modules in the PowerHub is displayed.

Following are some examples of the information displayed by this command. In the first example, summary information for all the LES and BUS services configured on the PowerCell 700 is displayed:

```
4:PowerHub:atm/lane# bus show all all
  Services on slot 1
  Slot  Name   Service Type       LES-SEL  BUS-SEL  Rate Group
  ----  ----   ------------       -------  -------  ----------
  1     sales  Colocated LES/BUS  0x10     0x20     1
```

The fields in this display show the following information:

Slot Indicates the PowerHub slot that contains the PowerCell 700 on which the listed service is configured.

Name Indicates the name of the ELAN served by the LES or BUS.

Service Type Indicates the service type. The service can be a BUS, a LES, or a colocated LES/BUS.

SEL Indicates the Selector byte of the LES, BUS, or colocated LES/BUS.

In the following example, detailed information for a specific LES (for the ELAN "engineering") is displayed. Detailed information is displayed only when information is requested about a specific service. If information is requested for more than one service, summary information is displayed:

```
4:PowerHub:atm/lane# les show engineering 1
LES Configuration for: engineering
---------------------------------------------------------------
LES ATM Address: 47:0005:80ff:e100:0000:f21a:2d09:0020481a2d09:10
BUS ATM Address: 47:0005:80ff:e100:0000:f21a:2d09:0020481a2d09:10
Proxy Party Count    : 1
Proxy PMP VPI        : 0
Proxy PMP VCI        : 84
Non-Proxy Party Count: 0
Non-Proxy PMP VPI    : 0
Non-Proxy PMP VCI    : 0
```

The fields in this display show the following information:

LES ATM Address	Indicates the ATM address of the LES.
BUS ATM Address	Indicates the ATM address of the BUS associated with this LES.
Proxy Party Count	Indicates how many ATM hosts that are proxies are served by the LES.
Proxy PMP VPI	For proxy hosts, shows the Point-to-Multipoint (PMP) Virtual Path Identifier (VPI) the LES is using.
Proxy PMP VCI	For proxy hosts, shows the PMP VCI the LES is using.
Non-Proxy Party Count	Indicates how many ATM hosts that are not proxies are served by the LES.
Non-Proxy PMP VPI	For non-proxy hosts, shows the PMP VPI the LES is using.
Non-Proxy PMP VPI	For non-proxy hosts, shows the PMP VPI the LES is using.
Non-Proxy PMP VCI	For non-proxy hosts, shows the PMP VCI the LES is using.

```
4:PowerHub:atm/lane# bus show eng-BUS 1
BUS Configuration for: eng-BUS
----------------------------------------------------
BUS ATM Address : 99:9999:9999:9999:9999:9999:9999:0000ef043480:20
BUS FORWARDING RATE GROUP: 1
BUS PARTY COUNT : 1
BUS PMP VPI     : 0
BUS PMP VCI     : 79
```

The fields in this display show the following information:

BUS ATM Address	Indicates the ATM address of the BUS.
BUS Forwarding Rate Group	Indicates the BUS forwarding rate group associated with the defined rate group.
BUS Party Count	Indicates how many ATM hosts that are proxies served by the BUS.
BUS PMP VPI	Indicates the PMP VPI the BUS is using.
BUS PMP VCI	Indicates the PMP VCI the BUS is using.

4.4.3.7 Displaying BUS Statistics

To display BUS statistics for a BUS configured on the PowerCell 700, issue the following command.

stats [show] bus ***<service-name>*****|all** ***<slot>*****|all**

<service-name>|all	Shows the service BUS configuration for the PowerCell module in the specified slot.
<slot>|all	The slot that contains the PowerCell 700. Slots are labeled on the chassis. If **all** is specified, statistics for all the BUSs on all PowerCell 700 Modules in the PowerHub are displayed.

Here is an example of this command:

```
4:PowerHub:atm# stats show bus elan 1
BUS Statistics For ELAN: elan1

---------------------------------------------------------------------------
Unicast Data In    :          2
Multicast Data In  :          2
Known Control In   :          0
Unknown Control In :          1
```

The fields in this display show the following information:

Unicast Data In	Indicates how many packets of unicast data the BUS for ELAN1 has received.
Multicast Data In	Indicates how many packets of multicast data the BUS has received.
Known Control In	Indicates how many control packets of a known type the BUS has received.
Unknown Control In	Indicates how many control packets of an unknown type the BUS has received.

4.4.3.8 Displaying LES Statistics

To display LES statistics for a LES configured on the PowerCell 700, issue the following command.

stats [show] les ***<service-name>*****|all** ***<slot>*****|all**

<service-name>|all	Shows the service LES configuration for the PowerCell module in the specified slot.

<slot>|all The slot that contains the PowerCell 700. TSlots are labeled on the chassis. If **`all`** is specified, statistics for all LESs on all PowerCell 700 Modules in the PowerHub are displayed.

Following is an example of this command:

```
4:PowerHub:atm#  stats show les engineering 1
ELAN Name: "elan1"
Join Request In          :           1
ARP Requests In          :           1
ARP Responses Out           :           1
ARP Requests Forwarded      :           1
Unknown Control In          :           1
```

The fields in this display show the following information:

Join Requests In Indicates a LEC request to join the LES.

ARP Requests In Indicates the number of LE_ARP requests received on this ELAN by the PowerCell module.

ARP Responses Out Indicates the number of LE_ARP responses sent on this ELAN by the PowerCell module.

ARP Requests Forwarded Indicates the number of LE_ARP requests forwarded on this ELAN by the PowerCell module.

Unknown Control In Indicates how many control packets of an unknown type the LES has received.

4.4.3.9 Clearing BUS Statistics from the PowerCell 700.

To delete statistics for a BUS configured on a PowerCell 700, issue the following command:

`stats clear bus` ***`<service-name>`*****`|all`** ***`<slot>`*****`|all`**

<service-name>|all Clears the service BUS configuration for the PowerCell module in the specified slot.

<slot>|all The slot that contains the PowerCell 700. TSlots are labeled on the chassis. If **`all`** is specified, statistics for all LESs on all PowerCell 700 Modules in the PowerHub are displayed.

4.4.3.10 Clearing LES Statistics from the PowerCell 700

To delete statistics for a LES that you have configured on the PowerCell 700, issue the following command:

stats clear les ***<service-name>*|all *<slot>*|all**

<service-name>|all Clears the service LES configuration for the PowerCell module in the specified slot.

<slot>|all Is the chassis slot that contains the PowerCell 700. The slots are labeled on the PowerHub 7000. If you specify all, statistics for **all** LESs on all PowerCell 700 Modules in the PowerHub are cleared.

4.4.4 Adding an ELAN

The **elan add** command allows ELANs to be added to PowerCell segments. To configure the required segments for LANE 1.0, issue the **atm sset protocol** command. When the segments are allocated, join the PowerCell LEC to an ELAN. Issue the following command to associate a PowerCell segment with the ELAN to join:

elan add ***<segment> <elan-name>*** **[la*<les-atm-address>*]**
[lu*<lecs-atm-address>*]

<segment> Specifies the segment of the ELAN to add (*<slot>*.*<seg#>*, where *<seg#>* is from **1** to **32**).

<elan-name> Specifies the name of the ELAN to add.

la<les-atm-address> Specifies ELAN LES address. The **les-address** parameter is required when the LECS has not been configured or when the LECS usage is not set. The LE Client forms a connection directly to the specified LES instead of the LECS.

lu<lecs-atm-address> Specifies the LECS to be used by the LE Client. When the **lecs-usage** parameter is used, the well known address is not used, but a LECS is enabled using the address provided. This parameter is used when the LECS is not located at the well-known address, and the **les-address** parameter is not set.

Following is an example of how to add an ELAN to the PowerCell segment. In this example, an ELAN named “elan1” is added to segment 1.6, the segment is enabled and the LECS is connected using the LECS well-known address.

```
5:PowerHub:atm/lane# elan add 1.6 elan1
```

Aparticular ELAN can be added to only one PowerCell segment and the ELAN name must be unique among the PowerCell segments in the same PowerHub. In addition, the ELAN name specified must match the ELAN name configured in LECS.

If the LECS was not configured, the LES address must be specified when adding the ELAN to the PowerCell module. Here is an example of how to specify the LES address:

```
atm/lane# elan add 1.6 elan1 la 47:0079:0000:0000:0000:0000:0000:00a03e000001:00
```

4.4.4.1 Changing ELAN Parameters

Use the **elan set** command to change the default for an ELAN parameter. Display the current settings for each parameter using the **elan show** command.

The LECS configuration file on the FORE ATM switch contains parameters similar to the ELAN parameters maintained by the PowerCell module. Most of the PowerCell defaults for the parameters match the defaults for the FORE LECS equivalents to these parameters. FORE Systems recommends that the defaults for these values be used. Setting parameters on the PowerHub overwrites values supplied by the LECs. The syntax for the **elan set** command is:

elan set *<elan-name>***|all arp-aging|aa** *<time>*
elan set *<elan-name>***|all bus-rate|br** *<packets per second>*
elan set *<elan-name>***|all control-timeout|cto** *<time>*
elan set *<elan-name>***|all flush-timeout|fto** *<time>*
elan set *<elan-name>***|all forward-delay|fd** *<time>*
elan set *<elan-name>***|all max-arp-retry|mar** *<count>*
elan set *<elan-name>***|all vcc-timeout|vto** *<time>*

<elan-name>|all Specifies the name of the ELAN for which to set ELAN parameters. If **all** is specified, the parameters are applied to all ELANs in the PowerHub.

Specify one of the following parameters with the **elan set** command and the value to assign to the parameter:

arp-aging|aa <time> Specify from **10** through **300** seconds. The default is **300**. The corresponding parameter in the LECS file is `.Aging_Time`.

bus-rate|br <packets per second>	Specify from **0** through **10** Packets Per Second. The default is **1**. The corresponding parameter in the LECS file is `.Maximum_Unknown_Frame_Time`.
<control-timeout|cto <time>	Specify from **10** through **600** seconds. The default is **120**. The corresponding parameter in the LECS file is `.Control_TimeOut`.
flush-timeout|fto <time>	Specify from **1** through **10** seconds. The default is **6**. The corresponding parameter in the LECS file is `.Flush_TimeOut`.
<forward-delay|fd <time>	Specify from **4** through **30** seconds. The default is **15**. The corresponding parameter in the LECS file is `.Forward_Delay_Time`.
max-arp-retry|mar <count>	Specify from **0** through **2** requests. The default is **2**. The corresponding parameter in the LECS file is `.Maximum_Retry_Count`.
vcc-timeout|vto <time>	Specify from **1** through **720** minutes. The default is **20**. The corresponding parameter in the LECS file is `.VCC_TimeOut_Period`.

4.4.5 Displaying an LE_ARP Table for an ELAN

The PowerHub maintains a separate LE_ARP table for each ELAN on the PowerCell module. The LE_ARP table maps the MAC addresses of the devices in an ELAN to their corresponding ATM addresses. To display the LE_ARP table for an ELAN, issue the following command:

at [show] elan=*<elan-name>*|addr=*<mac-address>*|all

elan=<elan-name>|addr=<mac-address>|all	Specifies an ELAN name or MAC address. If **all** is specified, LE_ARP table entries for all ELANs on all PowerCell modules in the PowerHub are displayed.

Following are some examples of the information displayed by this command. In the following example, the LE_ARP table entries for “elan1” are displayed.

```
5:PowerHub:atm# at show elan=elan1

ARP Table For ELAN: elan1
Seg. MAC Address         ATM Address
---------------------------------------------------------------------------
 1.3  00-20-48-1a-1e-3c   47:0005:80ff:e100:0000:f21a:1e3c:0020481a1e3c:10
 1.4  00-20-48-1b-1f-3d   47:0005:80ff:e100:0000:f21a:1e3c:0020481a1e3c:02
```

In the following example, a MAC address is specified. The ELAN name and ATM address corresponding to the MAC address are listed.

```
6:PowerHub:atm# at show 00-20-48-1a-1e-3c
ARP Table For MAC Address: 00-20-48-1a-1e-3c
Seg. Elan Name             ATM Address
 ---------------------------------------------------------------------------
 1.9  elan1                 47:0005:80ff:e100:0000:f21a:1e3c:0020481a1e3c:10
```

The fields in this display show the following information:

Seg Indicates the PowerHub segment on which the ELAN is configured.

MAC Address Indicates the MAC address of a LANE 1.0 device.

Elan Name Indicates the name of the ELAN.

ATM Address Indicates the ATM address of a LANE 1.0 device.

4.4.5.1 Clearing the LE_ARP Table

To clear an ELAN's LE_ARP table, issue the following command:

at clear *<elan-name>*|all

<elan-name>|all Specifies the name of the ELAN to clear the LE_ARP table. If **all** is specified, ARP tables for all ELANs on all PowerCell modules in the PowerHub are cleared.

4.4.6 Displaying the Virtual Circuits on an Elan

To display the VCs (Virtual Circuits) in use on an ELAN, issue the following command:

vt [show] *<elan-name>*|all

elan-name>|all Specifies the name of the ELAN to display the VC table. If **all** is specified, active VCs on all ELANs on all PowerCell modules in the PowerHub are displayed.

Following is an example of the information displayed by this command. In this example, the VC for “elan1” is displayed.

```
7:PowerHub:atm# vt show elan1
VC Table For ELAN: elan1

 Seg. MAC Address         VC
-----------------------------------------------------------------
  19  00-20-48-1a-1e-3c    67
```

The fields in this display show the following information:

Seg Indicates the PowerHub segment on which the ELAN is configured.

MAC Address Indicates the MAC address of the device at the other end of the VC.

VC Indicates the number of the VC connecting the ELAN on the PowerCell module to the other device. The VC number is negotiated by the PowerCell module and the ATM switch when the VC is established. The VC number can be different for each VC.

4.4.7 Displaying Statistics

The PowerCell module collects statistics for the data traffic and the control traffic sent and received by the ELANs configured on the PowerCell module. All statistics are collected on a per-ELAN basis.

- Statistics for data traffic are collected as interface statistics because the ELAN data packets are processed on the interface layer.
- Statistics for ATM control traffic are collected as ELAN statistics because they are processed on the ELAN layer.

To display ATM statistics, issue the following command:

stats [show] elan *<elan-name>***|all elan|if|all**

<elan-name>|all Specifies the name of the ELAN to display statistics. If **all** is specified, statistics for all the ELANs in the PowerHub are displayed.

elan|if|all Specifies the statistics you want displayed.

- elan — Displays ELAN (control) statistics.
- if — Displays interface (data) statistics.
- all — Displays ELAN and interface statistics.

Here is an example of the interface statistics displayed by this command. In this example and the following example, the statistics are displayed for an ELAN named "elan1."[1].

```
8:PowerHub:atm#  stats show elan1 if
Interface Statistics For ELAN: elan1
---------------------------------------------------------------------------
Out MCast Pkts    :          1
Out Errors        :          0
Out Discard       :          0
Out UCast Pkts    :          1
In MCast Pkts     :          0
In Errors         :          0
In Discard        :          0
In UCast Pkts     :          0
In Unknown Protos :          0
MTU size          :       1514
```

The fields in this display show the following information:

Out MCast Pkts Indicates the number of Ethernet broadcast or multicast packets the ELAN has sent to the ATM network.

Out Errors Indicates the number of Ethernet packets sent by the ELAN that experienced an error during transmission.

Out Discard Indicates the number of Ethernet packets that were discarded due to an error on the PowerCell module, rather than sent to the ATM network.

Out UCast Pkts Indicates the number of Ethernet unicast packets the ELAN has sent to the ATM network.

In MCast Pkts Indicates the number of Ethernet broadcast or multicast packets the ELAN has received from the ATM network.

---

[1]. The statistics displayed by the **`stats show elan`** command include FDDI traffic forwarded by the PowerCell module to the ATM network. However, the Packet Engine internally translates FDDI packets into Ethernet packets before forwarding them to intelligent NIMs such as the PowerCell module. In this way, the PowerCell module adheres to the LANE 1.0 standard while still translating traffic between FDDI and ATM networks.

In Errors Indicates the number of Ethernet packets received by the ELAN that contain errors.

In Discards Indicates the number of Ethernet packets that were discarded due to an error in the PowerCell module, rather than received for the ELAN.

In UCast Pkts Indicates the number of Ethernet unicast packets the ELAN has received from the ATM network.

In Unknown Protos Indicates the number of Ethernet packets received that were using an unknown protocol.

MTU size Indicates the MTU (maximum transmission unit) for the protocol being used in the ELAN. For Ethernet, the MTU is 1514 bytes.[1]

Following is an example of the ELAN statistics displayed for an ELAN.

```
9:PowerHub:atm# elan show elan1 elan
ELAN Statistics For ELAN: elan1
---------------------------------------------------------------------------
SVCs Released     :          1
Total Control In  :          5
Total Control Out :          5
ARP Replies In    :          2
ARP Replies Out   :          0
ARP Request In    :          0
ARP Request Out   :          2
Join ELAN Calls   :          1
```

The fields in this display show the following information:

SVCs Released Indicates the number of Switched Virtual Circuits (SVCs) that have been released (torn down) by this ELAN. An SVC is released after the two ends of the SVC (the ELAN on the PowerCell module and the device on the other end) stop exchanging traffic.

Total Control In Indicates the number of LANE 1.0 control packets received on this ELAN by the PowerCell module.

Total Control Out Indicates the number of LANE 1.0 control packets sent on this ELAN by the PowerCell module.

ARP Replies In Indicates the number of LE_ARP replies received on this ELAN by the PowerCell module.

1. This does not include the 4-byte CRC added to the packet by the Ethernet chip.

ARP Replies Out Indicates the number of LE_ARP replies sent on this ELAN by the PowerCell module.

ARP Request In Indicates the number of LE_ARP requests received on this ELAN by the PowerCell module.

Arp Request Out Indicates the number of LE_ARP requests sent on this ELAN by the PowerCell module.

Join ELAN Calls Indicates the number of times an ELAN on the PowerCell module has requested to join the like-named ELAN configured on the ATM switch.

4.4.8 Clearing Statistics

To clear ATM statistics, issue the following command:

`stats clear elan` ***<elan-name>*****`|all`**

<elan-name>|all Specifies the name of the ELAN for which to clear statistics. If **`all`** is specified, statistics for all the ELANs in the PowerHub are cleared.

4.5 LEC Failover Support

The PowerHub supports *ForeThought*'s LEC failover mechanism. The LEC failover mechanism provides redundancy by an ELAN to be associated with multiple LESs. The ELAN uses only one of the LESs for ELAN traffic, but if that LES fails, the software automatically uses another LES. Up to two backup LESs can be specified for each ELAN. For information on configuring the LEC failover mechanism on the PowerCell module, see Section 4.5.1.

4.5.1 Implementing the Failover Mechanism

To implement the failover mechanism for an ELAN, do the following:

1. Add the LES/BUS pairs. Up to three LES/BUS pairs to the PowerCell module, ATM switch, or Host where the LES/BUS is to reside. To assign an instance, use a vertical bar (**|**) to separate the ELAN name from the LEC instance. If a LECS is not to be used, include the full ATM NSAP address of the LES. To configure a LES/BUS pair on a PowerCell segment, use the **`les add`** command.

2. Configure the LECS. The LECS must be configured to match the LES/BUS selector bytes and instances for each ELAN. This must be done unless no LECS is to be used in the ELAN, in which case the full LES/BUS ATM NSAP address (and not just selector byte) must be specified in the ELAN configuration step. To configure a LECS, see the *ForeRunner ATM Switch Configuration Manual*, or the *ForeRunner SBA-200 ATM SBus Adapter User's Manual.*
3. Configure the ELAN instances. Again, use the same ELAN name with a vertical bar (**|**) to separate the ELAN name from the LES instance with the same segment number of the LEC.

All three instances of the ELAN name reside on the same PowerCell segment, but only one instance is active. The PowerHub implementation of the failover mechanism is transparent to PowerHub bridging and routing. The PowerHub bridging and routing software continue to use the same segment number for the ELAN, regardless of the LES instance that is active. Figure 4.5 shows an example of how the failover mechanism is used on the PowerCell module.

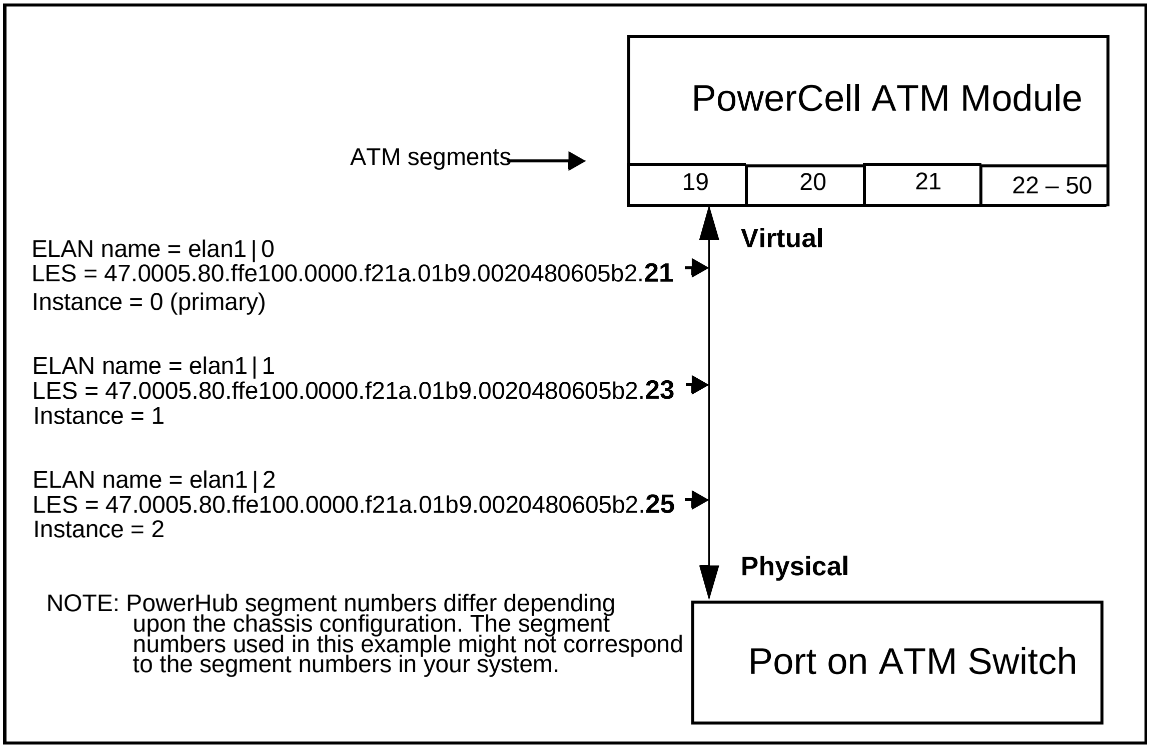

Figure 4.5 - Example of Failover Mechanism on A PowerCell Module

In Figure 4.5, three instances of elan1 have been added to PowerCell segment 19 as three distinct ELANs: **elan1|0**, **elan1|1**, and **elan1|2**. A LES address has been specified for each instance, either using the PowerHub **elan add** command or using entries in the LECS configuration file.

The LESs are distinguished in this example by the Selector bytes (21, 23, and 25). Specify the LES address, including the Selector bytes, when adding an ELAN to a PowerCell segment. Specify the LES addresses when adding the ELANs to the PowerCell module. However, it is not necessary to specify the LES addresses on the PowerCell module if a LECS is being used and the LES addresses have been specified (and failover instances) in the LECS configuration file.

After the failover mechanism switches to LES instance 1 (the backup LES), the software periodically attempts to re-establish connection to the primary LES (instance 0). When a LES fails, or when the failover mechanism attempts to re-establish connection to the primary LES, traffic on the PowerCell module is momentarily interrupted while the software establishes VCs to the new LES and flushes the LE_ARP, bridge, and route caches on the module.

Use the commands in the following sections to implement the LEC failover mechanism on a PowerCell module. These commands implement the failover feature in a PowerCell module only. To implement the failover mechanism on the ATM switch, see the ATM switch documentation.

4.5.1.1 Preparing the LECs for the Failover Mechanism

Before adding the ELAN to the PowerCell segments, add the desired LES/BUS pairs on two different nodes and implement the failover mechanism in the LECS configuration file. Use the **les add** command to configure the LES/BUS pairs. See the *ForeRunner ATM Switch Configuration Manual*, or the *ForeRunner SBA-200 ATM SBus Adapter User's Manual* for information on configuring the LECS.

4.5.1.2 Determining Which LES and BUS Are in Use

The LES and BUS an ELAN is using can be determined at any time by issuing the **elan [show]** command

4.5.2 Verifying the PowerCell LANE 1.0 Configuration

After configuring the PowerCell module as a LEC, the LEC software on the module serves all the ATM segments on that module the configured for LANE 1.0. To show the LEC that is to be used by all the LECs, issue the following command:

lec [show] *<slot>*|all

<slot>|all Specifies the slot that contains the PowerCell module.

Slots are labeled on the chassis. Slot numbers can also be determined by using the **system config show** command. If **all** is specified, the LEC configuration for all the PowerHub modules in the chassis is displayed.

Following is an example of the information displayed by this command. The “LE Client” is the LEC (PowerCell module).

```
8:PowerHub:atm/lane# lec show 4
LEC Configuration For slot: 4
---------------------------------------------------------------
LE Client State : Enabled
LE Client ATMAdd:47:0005:80ff:e100:0000:f21a:1e3c:0000ef0282d0:00
LECS ATM Address: 47:0079:0000:0000:0000:0000:0000:00a03e000001:00
```

The fields in this display show the following information:

LE Client State Indicates whether the PowerCell module is enabled as a LEC.

LE Client ATM Address Indicates the ATM address of the PowerCell module. The address displayed is the base address of the LEC (PowerCell module). The Selector byte contains zeroes (00). Each ELAN configured on the PowerCell module uses the base address but has a unique value in the Selector byte.

LECS ATM Address Indicates the ATM address of the LECS (LAN Emulation Configuration Server).

4.6 LANE 1.0 Configuration Examples

Depending upon the ATM hardware and software, these items can be configured on the ATM switch, on a workstation, or might be distributed between the ATM switch and a workstation. For example, the LECS may be installed on a Sun workstation and the LES and BUS on the FORE switch, as shown in Figure 4.6.

NOTE

In software version 7-2.6.4.0 and later, configure the LES and BUS on the PowerCell 700. Figure 4.6 shows the LES and BUS configured on the ATM switch.

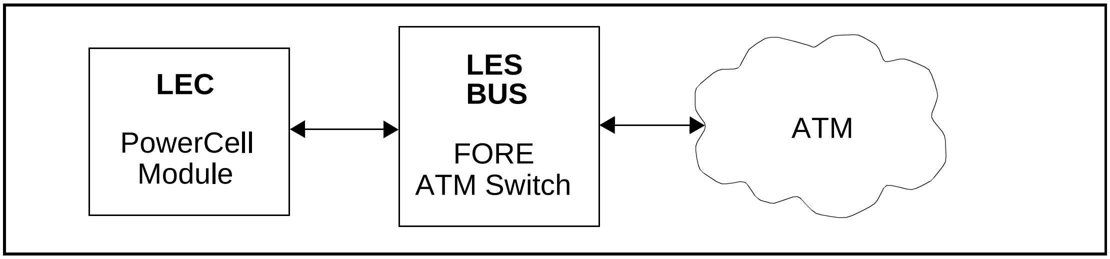

Figure 4.6 - Example of LECS Configuration on a Sun Workstation

Table 4.1 lists the hardware used for each LANE 1.0 component.

Table 4.1 - Lane Component Hardware Table

LANE 1.0 Component	Hardware	Software
LEC	PowerCell module	ELAN names. Each ELAN is associated with an ATM segment. If no LECS is configured, the ATM address of the LES is specified with each ELAN name.
LES and BUS	ASX-200BX ATM Switch	ATM addresses of the LES and BUS. In this example, the LES and BUS are *colocated* (located on the same machine).
LECS	SBA-200 ATM Adapter Card (installed on Sun workstation)	LECS configuration file. Contains the ATM addresses of the ELANs. Also contains filters for accepting or discarding specific ATM addresses.

NOTE

If a LECS is unavailable or you cannot add a LECS, you can still use ELANs if you supply the LES address when you add the ELANs.

4.6.1 LEC Example (PowerCell 700)]

Before segments can begin switching in the LANE 1.0 environment, add an ELAN to each segment, as shown in the following example. The terse form of the **`elan add`** command is used.

```
13:PowerHub:atm/lane# elan add 1.9 elan1|0
14:PowerHub:atm/lane# elan add 1.9 elan1|1
15:PowerHub:atm/lane# elan add 1.9 elan1|1
16:PowerHub:atm/lane# elan add 1.8 elan2 s
```

When adding the ELANs to the segment using the **`elan add`** command, the ELAN is automatically enabled to get information from the LECS and the LEC software is started on the PowerCell module.

CHAPTER 5 FORE IP

This chapter describes PowerHub support for the FORE IP ATM protocol. FORE IP is a FORE Systems ATM protocol that emulates basic characteristics of an IP network.

NOTE

If setting up a new ATM network, FORE Systems recommends that LANE 1.0 be used to bridge or route between ATM and Ethernet (and FDDI). Configure FORE IP on the PowerCell module only if the ATM network already uses FORE IP.

The PowerHub 7000 cannot form FORE IP connections to FORE Systems model ASX-1000 or ASX-200 ATM switches. Connections can be formed ***through*** the switch, but not ***to*** the switch. FORE Systems model ASX-200BX and ASX-1000 support AAL 5; therefore FORE IP connections can be made to these switches.

5.1 IP Characteristics Emulated by FORE IP

FORE IP emulates the following characteristics of the IP protocol:

- Address resolution using ARP.
- Dynamic connection establishment and teardown.
- Broadcast and multicast capability.

The FORE-IP implementation incorporates these services in software, using FORE System’s Simple Protocol for ATM Network Signalling (SPANS) and a Connectionless Service (CLS).

NOTE

The virtual interfaces created in FORE IP are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, not bridged, when destined for any other interfaces on the PowerHub.
or
The FORE IP implementation works on the Network layer of the OSI model, and resolves IP addresses to ATM address. It does not use MAC addresses so there are none to use to Bridge. Because of this, all traffic destined for other interfaces on the PowerHub must be routed.

NOTE

Because SPANS addressing does not have a selector byte that can be assigned to multiple IP addresses to 1 segment, only assign FORE IP as the protocol for 1 segment of a given PowerCell.

5.2 The PowerCell Module and FORE IP

FORE IP networks contain the following components:

Simple Protocol for ATM Network Signalling (SPANS)
FORE System's proprietary signaling protocol for use in ATM local-area networks. SPANs signaling occurs over VPI/VCI 0,15.

Connectionless Service (CLS)
A service that provides transport of connectionless traffic (IP broadcasts, OSPF, RIP, ARP requests and ARP responses) through an ATM network. An ATM network contains only one CLS. Connectionless traffic, including FORE IP traffic, is forwarded to and from the CLS using the well-known VPI/VCI pair 0,14.

NOTE

All FORE IP switched virtual circuits established using SPANs signaling are unidirectional. Each FORE IP connection requires an inbound VC and an outbound VC.

5.2.1 ARP Requests and Responses

ARP requests and responses are sent over a connectionless service, in conformance with RFC826. The HARDWARE Type value in the ARP packet is set to 4040 (hex). The protocol type is set to 0800 (the Ethernet Type for IP packets). The hardware addresses for FORE in the ARP packets are the 8-byte SPANS ATM addresses.

5.2.2 IP Broadcasts

IP broadcast packets are dealt with in the same manner as ARP packets are—over the pre-defined VPI/VCI pair of 0,14. 0,14 is the VPI/VCI pair used for the CLS.

5.2.3 Point-to-Point IP Packets

Point-to-point IP packets are connection-oriented in nature, therefore virtual circuits between IP hosts or ATM switches must be established. FORE-IP provides dynamic connection establishment using SPANS. For an existing connection between two IP hosts, IP packets are forwarded out the appropriate virtual circuit using the correct AAL type. If a connection does not exist, SPANS establishes a new connection.

5.2.4 IP Multicast

Point-to-multipoint connections are used for supporting IP multicast traffic over an ATM network, such that IP multicast packets can be transmitted from one source to multiple destinations. These point-to-multipoint connections are created using SPANS group addresses. An end station must first be added to the point-to-multipoint connection for the particular IP multicast group before the end station can receive IP multicast packets. The end station joins the multicast group by opening a point-to-multipoint connection to the group. IP Multicasting is supported by hardware point-to-multipoint connections on FORE Systems products, therefore no special multicast processing is needed to service such multicast packets.

5.2.5 Configuring the ATM Switch for FORE IP

The PowerCell module supports FORE IP, the FORE Systems proprietary protocol that emulates IP on the ATM network. FORE IP uses SPANS 1.0, the FORE Systems proprietary signalling protocol, to dynamically establish and teardown VCs .

NOTE

Disregard the procedures in this section if:

- SPANS 1.0 on the ATM switch ports has already been configured for AAL5.

- Do not plan to use the FORE IP protocol.

(Segments for FORE IP can be reserved without actually enabling the protocol. If FORE IP segments are reserved in this way, configure the ATM switch before enabling FORE IP on the PowerHub. If these steps are not performed, FORE IP fails to operate when the protocol is enabled on the reserved segments.)

In order for the ATM switch and the PowerHub to communicate using FORE IP, both devices must be using the same ATM Adaptation Layer (AAL). For SPANS, the PowerCell module uses AAL5. However, by default, FORE Systems ATM switches support AAL3/4.

For the PowerCell module to communicate with FORE Systems ATM switches using FORE IP, SPANS AAL configuration on the port that directly connects the PowerCell module and the ATM switch must be changed to AAL5. For more information about SPANS AAL configuration, see your ATM switch manual.

5.3 Configuring for FORE IP

To use the PowerCell module for routing in a FORE IP network, perform the following configuration tasks:

5.3.1 Configuring FORE IP on a PowerCell Segment

- Configure one or more IP interfaces on the FORE IP segment (if not already done). For more information about adding an IP interface, see the *PowerHub Software Reference Manual*.)
- Set the ATM protocol type to FORE IP.
- Enable IP forwarding on a PowerHub.
- Enable FORE IP on the PowerCell segments configured for FORE IP.

NOTE The IP address assigned to a FORE IP segment on the PowerHub can not be used on any other segment.

5.3.1.1 Enabling FORE IP on a PowerCell Segment

After configuring a PowerCell segment and an ATM switch to use FORE IP, enable FORE IP on the segment. To enable FORE IP on a PowerCell segment, issue the following command:

`senable/sdisable` ***`<seglist>`***

<seglist> Specifies the PowerCell segment on which FORE IP is being enabled.

Following is an example of this command.

```
1:PowerHub:atm/foreip# senable 1.4
```

NOTE Only one FORE IP segment can be configured on a PowerCell.

NOTE A FORE IP segment can have one or more IP interfaces.

To disable FORE IP on a PowerCell segment, use the **`sdisable`** command. Following is an example of the command:

```
5:PowerHub:atm/foreip# sdisable
```

When FORE IP is disabled on the segment, the segment displays as disabled when the PowerCell configuration is verified using the **`atm config show`** command. After disabling FORE IP, it can be re-enabled, or assign another protocol to the segment using the **`atm sset protocol`** command and configure the segment to use another protocol.

5.3.1.2 Displaying the Outbound Segment's Cache

The PowerHub FORE IP software maintains a cache of the outbound VCs for each PowerCell segment configured for FORE IP. The FORE IP cache maps the IP address of a switch or end station to its corresponding SPANS address. The IP addresses can be for local or remote switches or end stations reachable through the corresponding SPANS addresses.

To display the FORE IP cache for a PowerCell segment, issue the following command:

cache [show] *<seglist>*

<seglist> Specifies the PowerCell segment to display the FORE IP cache.

Following is an example of the information displayed by this command. In this example, the FORE IP cache for segment 1.7 is displayed.

```
10:PowerHub:atm/foreip# cache show 1.7
IP Address          Out VC     SPANS Address
----------          ------     -------------
134.163.20.3        121        00-00-00-01-f2-1a-23-bd
```

The fields in this display show the following information:

IP Address Indicates the destination IP address of the switch or the remote FORE IP workstation attached to the PowerCell segment.

Out VC Indicates the virtual channel identifier of the outbound VC. This VC is established by SPANS and is used by the PowerCell module to send FORE IP traffic from the PowerCell segment to the ATM switch or end station.

SPANS Address Indicates the destination SPANS address of the remote FORE IP workstation directly attached to the PowerCell segment.

In the following example, a single VC and SPANS address are associated with multiple IP addresses. This type of display is typical in configurations where multiple FORE IP end stations or ATM switches can be reached through the ATM switch attached to a PowerCell segment.

```
10:PowerHub:atm/foreip# show cache 1.7
IP Address          Out VC     SPANS Address
----------          ------     -------------
134.163.20.3        121        00-00-00-01-f2-1a-23-bd
134.163.20.4        121        00-00-00-01-f2-1a-23-bd
134.163.20.5        121        00-00-00-01-f2-1a-23-bd
134.163.20.6        121        00-00-00-01-f2-1a-23-bd
```

In the example above, four different IP addresses can be reached through VC 121 and SPANS address 00-00-00-01-f2-1a-23-bd. The ATM switch associated with the SPANS address is locally attached. The IP addresses can be for the ATM switch or end station itself, or for other ATM switches or end stations that can be reached through the ATM switch associated with the SPANS address.

5.3.1.3 Displaying FORE IP Statistics

The PowerHub maintains FORE IP statistics for each PowerCell segment enabled for FORE IP. To display the FORE IP statistics for a PowerCell segment, issue the following command:

stats [show] ***<seglist>***

<seglist> Specifies the PowerCell segment to display the FORE IP statistics.

Following is an example of the information displayed by this command. In this example, the FORE IP cache for segment 1.7 is displayed.

```
10:PowerHub:atm/foreip# stats show 1.7
FORE-IP packet statistics for segment 1.7
   Total Pkts sent:              394
   Total ARP Pkts sent to CLS:   5
   Total BMCAST Pkts sent to CLS: 0
   Total Unicast Pkts sent:      389
   Total Pkts received:          426
   Total ARP Pkts received:      5
   Total BMCAST Pkts received:   0
   Total Unicast received:       421
   Total Pkts dropped:           0
   Total Pkts not sent:          0
   Total Pkts forwarded to PE:   389
   Total Pkts with bad length:   0
```

The fields in this display show the following information:

Total Pkts sent Indicates the total number of FORE IP packets sent on this PowerCell segment.

Total ARP Pkts sent to CLS Indicates the total number of FORE IP ARP packets sent by this PowerCell segment to the FORE IP CLS.

Total BMCAST Pkts sent to CLS Indicates the total number of FORE IP broadcast or multicast packets sent by this PowerCell segment to the FORE IP CLS.

Total Unicast Pkts sent Indicates the total number of FORE IP unicast packets sent by this PowerCell segment.

Total Pkts received Indicates the total number of FORE IP packets received on this PowerCell segment.

Total ARP Pkts received Indicates the total number of FORE IP ARP packets received on this PowerCell segment from the FORE IP CLS.

Total BMCAST Pkts received Indicates the total number of FORE IP broadcast or multicast packets received on this PowerCell segment from the FORE IP CLS.

Total Unicast Pkts received Indicates the total number of FORE IP unicast packets received on this PowerCell segment.

Total Pkts dropped Indicates the total number of packets dropped by this PowerCell segment.

Total Pkts not sent Indicates the total number of packets that were not sent by this PowerCell segment.

Total Pkts forwarded to PE Indicates the total number of FORE IP packets forwarded to the Packet Engine by this PowerCell segment. After receiving the packets from the PowerCell module, the Packet Engine discards or forwards the packets as needed.

Total Pkts with bad length Indicates the total number of FORE IP packets that did not have the correct length.

5.3.1.4 Clearing FORE IP Statistics

To clear FORE IP Statistics for a PowerCell segment, issue the following command:

```
stats clear <seglist>
```

After clearing the FORE IP statistics, the PowerCell module begins accumulating new statistics.

5.3.2 Configuring A FORE IP Network for Failover

A FORE IP network can be configured so that network connections are sustained if a failure occurs in one of the links between the PowerCell modules and ATM switches. To configure for failover, at least two PowerCell systems containing PowerCell modules and at least two ATM switches are required. Figure 5.1 shows an example of a FORE IP failover configuration.

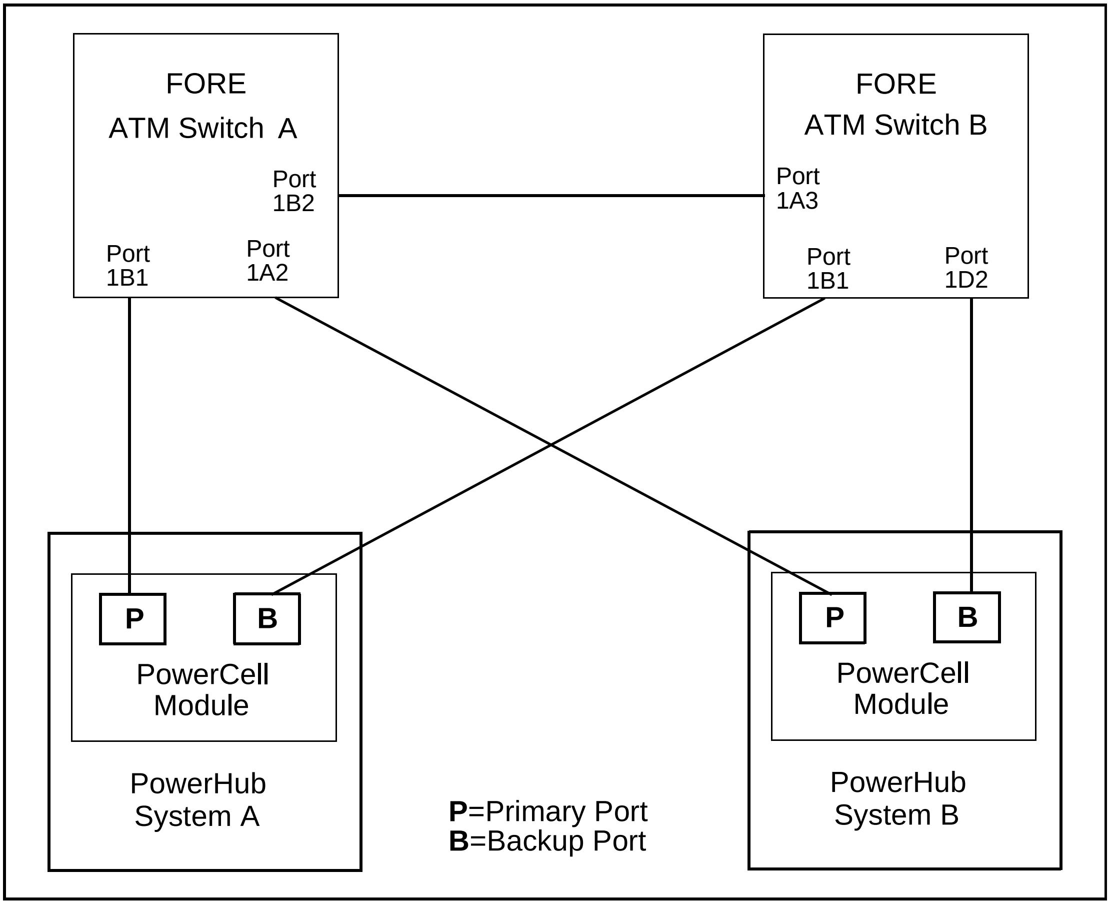

Figure 5.1 - Failover Configuration for FORE IP

To set up the configuration shown in Figure 5.1:

1. Connect the PowerHub modules to the ATM switches as shown in Figure 5.1.
2. If not already done, configure the FORE IP ports on the ATM switches to use interface `asx0`.
3. If not already done, enable FORE IP on the PowerCell segments for the FORE IP connections with the ASX switches.

NOTE

It is not important which ports on the ATM switches the Fiber or UTP cables are plugged into, as long as the primary and backup ports on the PowerCell are connected to the correct switches as shown in Figure 5.1.

CHAPTER 6 Classical IP over ATM

This chapter describes the PowerHub support for (Classical IP over ATM) (CLIP). CLIP is an ATM Forum standard that IP datagrams and Address Resolution Protocol (ARP) requests and replies to be transmitted over ATM using ATM Adaptation Layer 5 (AAL5). CLIP is described in RFC 1577.

6.1 The PowerCell Module and CLIP

CLIP networks contain the following components:

Logical IP Subnet (LIS) A group of IP hosts or routers that are directly attached to an ATM switch and have the same IP network address, subnet address, and subnet mask. You can configure one LIS on each PowerCell segment you use for CLIP. After the CLIP network is initialized, individual members of the LIS are joined directly to other members by VCs (Virtual Channels). Hosts that are not members of the LIS can be reached only by using a LAN router (such as the PowerHub 7000).

ATM ARP server A device that can translate IP addresses into ATM addresses. When the ATM ARP server receives an ARP request from a host in an LIS, the ATM ARP server looks up the IP address supplied in the ARP request and returns the ATM address.

Virtual interfaces that are created in CLIP are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, not bridged, when destined for any other interfaces on the PowerHub, including another LIS on the same PowerCell module.

Figure 6.1 shows an example of an ATM network using CLIP. Notice that each ATM host is a member of an LIS. In this example, the hosts are grouped into two LISs: 147.128.10.x and 147.128.20.x. The subnet mask used in the following example is 255.255.255.0.

NOTE In release PH_FT4.0.0, the PowerHub cannot be the CLIP ARP server.

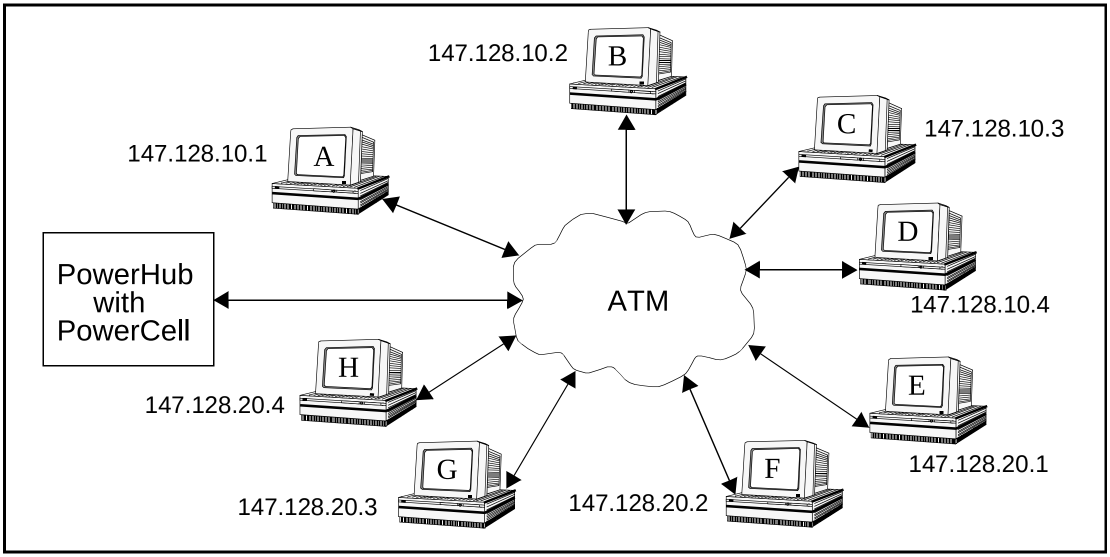

Figure 6.1 - CLIP Network

Figure 6.2 shows the same network from the PowerHub system's perspective. Each LIS is associated with its own PowerCell segment.

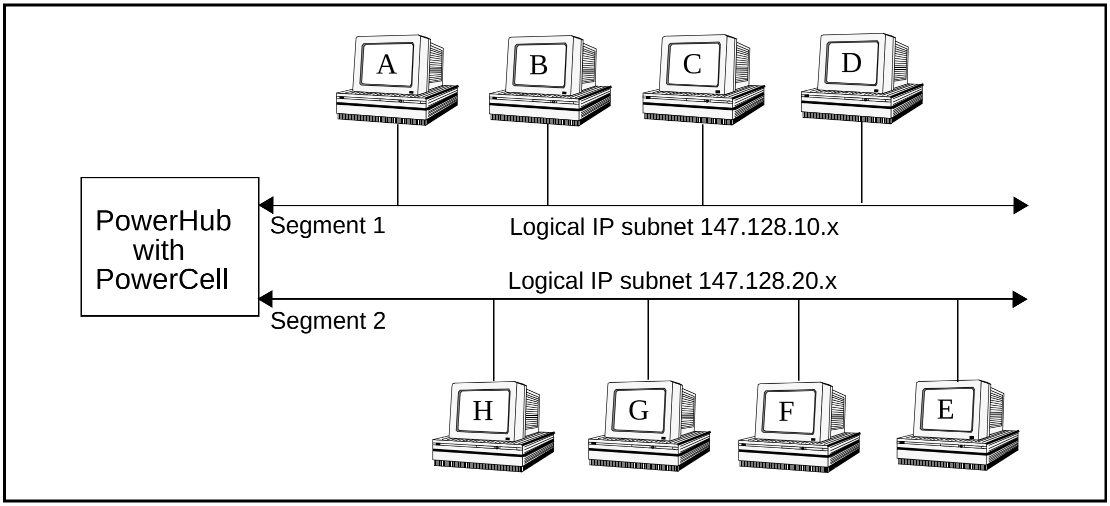

Figure 6.2 - CLIP Network Containing LISs

Figure 6.1 and Figure 6.2 show two LISs connected to a PowerCell module, which is installed in a PowerHub. Without a router to connect the LISs, the members of LISs cannot communicate with each other. The PowerCell module enables the LISs to communicate by routing IP traffic between the LISs.

6.1.1 SVC Support and Packet Encapsulation

The PowerCell module establishes connections between members of an LIS using SVCs. To establish an SVC, the PowerCell software uses Q.2931 signalling, as specified in the ATM Forum's UNI 3.0 Specification.

After the PowerCell software establishes an SVC, the software encapsulates IP packets using IEEE 802.2 LLC/SNAP encapsulation, and segments the packets into ATM cells using AAL5.

The default MTU is 9,180 bytes. When the SNAP header is added, the size becomes 9,188 bytes. The maximum IP datagram is 9180.

6.1.2 ATM ARP Support

CLIP uses ATM ARP and Inverse ATM ARP for address resolution within an LIS. ATM ARP is based on RFC 826 and Inverse ATM ARP is based on RFC 1293.

To configure a PowerCell segment to use an ATM ARP server in an LIS, specify the ATM Address of the ATM ARP server when configuring the PowerCell segment for CLIP. Perform this and other tasks using the **`clip sset`** command. See Section 6.2.2.

Each LIS must have one ATM ARP server. The same ATM ARP server can be shared across multiple LISs, but an LIS cannot contain two operational ARP servers. The ATM ARP server must have authoritative responsibility for resolving ATM ARP Requests from all IP nodes within the LIS.

When configuring the ATM ARP server, an IP address must be configured for each LIS the server supports.

When configuring an IP node for CLIP, the ATM address of the ATM ARP server must be specified in the LIS to which the node belongs. For example, when configuring a PowerCell segment for CLIP, one of the configuration tasks that must be performed is to specify the ATM address of the ATM ARP server.

6.1.2.1 ATM ARP Table Aging

ATM ARP entries in the ATM ARP table on the ATM ARP server are valid for a minimum of 20 minutes. Configure the aging interval for the ATM ARP entries on the ATM ARP server itself. See the documentation for your ATM ARP server for information.

After the aging interval on the server expires, the server generates an Inverse ARP Request on the open VC (if any) associated with the ARP entry.

- If the server receives an Inverse ARP Reply on a VC, the entry is updated and the aging timer starts over for the entry.
- If the server does not receive at least one Inverse ARP Reply, the server removes the entry from its ATM ARP table.

6.1.3 MTU Size

The default MTU size for IP members operating over the ATM network is 9180 bytes. The LLC/SNAP header is 8 bytes, therefore the default ATM AAL5 protocol data unit size is 9188 bytes. In Classical IP subnets, values other than the default can be used if and only if all members in the LIS have been configured to use the non-default value.

If a Classical IP packet is locally forwarded by the PowerCell module from one LIS to another LIS attached to the module, the packet is forwarded without being fragmented. However, if the PowerCell module sends the packet to the Packet Engine for processing (for example, if the packet is destined for a segment on another module in the PowerHub), the module fragments the packet before sending it to the Packet Engine. The fragments can be a maximum of 4060 bytes long. The fragment sizes depend upon the destination medium (ATM, FDDI, or Ethernet).

6.2 Configuring a PowerCell Segment for Classical IP

To use a PowerCell segment for Classical IP routing in an ATM network, perform the following configuration tasks for each segment:

- Configure an IP interface on the segment (if not already done). (Use the **`ip interface add`** command.
- Set the ATM protocol type to CLIP. (Use the **`sset protocol`** command.
- Specify the ATM address of the ATM ARP server attached to the segment and enable Classical IP on the segment. (Use the **`clip sset`** command.)

The following sections describe how to perform these tasks.

6.2.1 Configuration Considerations

Before configuring the PowerCell module for CLIP, make sure the configuration plans are not affected by the following considerations:

- Only one IP interface can be configured on a PowerCell segment enabled for Classical IP.

NOTE

IP routes must be statically configured on a PowerCell segment enabled for Classical IP.

- Broadcast traffic, such as RIP or OSPF, is not supported, as there is no mechanism in place to distribute broadcast packets. If the segments being configured require the ability to send and receive broadcast traffic, use LANE 1.0 on the segments.
- One IP interface can be configured on a PowerCell segment, for a maximum of 32 IP interfaces on a PowerCell module.
- Layer-3 VLANs are not supported on PowerCell segments configured for CLIP. To configure a Layer-3 VLAN on multiple PowerCell segments, use LANE 1.0 or 1483 LANE Frame PVCs on the segments.
- Do not include the segments that are configured for CLIP in PowerHub bridge (network) groups.

6.2.2 Configuring a Segment for Classical IP on ATM

Before enabling CLIP on a segment, configure the PowerCell segment to use PVC Bridging using the **atm sset protocol** command. To configure the PowerCell segment to use CLIP, telnet into or connect to the PowerHub through the TTY interface, change to the **atm** subsystem, and configure the desired segment. After configuring a PowerCell segment to use CLIP:

- Specify the ATM address of the ATM ARP server. (This must be done before enabling Classical IP on the segment.)
- Enable Classical IP on the segment.

To perform these tasks, use the **atmarp sset** command. The syntax for this command is:

atmarp-addr|as sset *<arpsvr-atm-addr> <seglist>*

<arpsvr-atm-addr> Specifies the ATM address of the ATM ARP server. Specify the address in NSAP format.

Classical IP over ATM

<seglist> Specifies the PowerCell segment being configuried for Classical IP.

Here are some examples of the **atmarp sset** command. The first command in this example specifies the ATM address of the ARP server on the LIS. The second command enables Classical IP on segment 2.2. In both cases, the terse form of the **senable** command is used.

```
10:PowerHub:atm/clip# as sset 45.0005.80.ffe100.0000.f215.1490.00-00-ef-01-ab-cd.04 2.2
Okay
11:PowerHub:atm/clip# senable segment
Enable CLIP segment
```

6.2.2.1 Configuring ARP-Aging on the ATM ARP Server

To set ARP-aging on the ARP server, use the **arp-aging sset** command. The syntax for this command is:

arp-aging|aa sset *<seconds> <seglist>*

<seconds> Specifies the maximum time that an ATM ARP entry is kept without being used. The minimum value that can be set is **10** seconds and the maximum value is **600** seconds. The default is **300** seconds.

<seglist> Specifies the segment being configured for ARP-aging.

Here is an example of the **arp-aging sset** command.

```
10:PowerHub:atm# aa sset 500 1.4
Okay
```

6.2.2.2 Configuring ARP-Aging Timeout

To set ARP-aging timeout on the ARP server, use the **arp-conn-timeout sset** command. The syntax for this command is:

arp-conn-timeout|at sset *<seconds> <seglist>*

<seconds> Specifies the time to wait when connecting to an ARP server to detect if the attempt failed. The PowerHub automatically tries to reconnect if the attempt failed. The minimum value that can be set is **5** seconds and the maximum value is **60** seconds. The default is **10** seconds.

<seglist> Specifies the segment being configured for ARP-aging timeout.

Following is an example of the **arp-conn-timeout sset** command.

```
10:PowerHub:atm# at sset 35 1.4
Okay
```

6.2.3 Displaying the Classical IP Configuration

To verify the Classical IP configuration of a PowerCell segment, issue the following command:

config [show] [local|l] *<seglist>*|**all**

[local|l]	Specifies the locally stored information on the packet engine.
<seglist>|all	Specifies the PowerCell segment(s) to display the Classical IP configuration. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If **all** is specified, configuration information is displayed for all the PowerCell segments in the chassis that are configured for Classical IP.

Following is an example of this command.

```
10:PowerHub:atm/clip# config show 2.2
Show remote config for segment 2.2
Displaying information from the ATM card for segment22
Classical-IP-over-ATM Configuration segment 22
-------------------------------------------------------------------
IP address:              111.22.33.4
Interface ATM Address:   47.0005.80.ffe100.0000.f215.1490.00-00-ef-01-cd-ba.06
ATM ARP Svr Addr:        45.0005.80.ffe100.0000.f215.1490.00-00-ef-01-ab-cd.04
Admin Status:            Enabled
Physical State:          Up
Oper. State:             Running (SVC Mode)
IP/IF Stats:             IP/IF configured
Arp Age (secs):          1200000
Arp conn timout (secs)   1200000
```

The fields in this display show the following information:

`ATM ARP Svr Addr`	Displays the ATM address of the ATM ARP server for the LIS.

Classical IP over ATM

6.2.4 Displaying Classical IP Statistics

To display Classical IP statistics for a PowerCell segment, issue the following command:

`stats [show] <seglist>|all`

<seglist>|all Specifies the PowerCell segment(s) to display Classical IP statistics. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If **`all`** is specified, statistics are displayed for all the PowerCell segments in the chassis that are configured for Classical IP.

Following is an example of this command.

```
10:PowerHub:atm# stats show 2.2
Classical IP Statistics for Interface 147.128.10.1 on segment 2.2
-------------------------------------------------------------------
In UCast Pkts:       347789
In Mcast Pkts:       233
Out UCast Pkts:      4172
Out Mcast Pkts:      499
In Errors:           2
In Discard:          23
Out Pkts Dropped:    311
Out ARP Req:         45
In ARP Req:          3
In InARP Req:        2
In ARP Rep:          41
Out ARP Rep:         3
ARP Age Cnt:         48
```

The fields in this display show the following information:

In UCast Pkts Indicates the number of unicast packets received on the PowerCell segment(s).

In Mcast Pkts Indicates the number of multicast packets received on the PowerCell segment(s).

Out UCast Pkts Indicates the number of unicast packets sent on the PowerCell segment(s).

Out Mcast Pkts Indicates the number of multicast packets sent on the PowerCell segment(s).

In Errors Indicates the number of packets containing errors received on the segment(s).

In Discard Indicates the number of packets received on the segment(s) that were discarded by the PowerCell module.

Out Pkts Dropped Indicates the number of outgoing packets that were dropped by the PowerCell module, rather than sent.

Out ARP Req Indicates the number of ARP requests sent to the LIS ARP server on the segment.

In ARP Req Indicates the number of ARP requests received from the LIS on the segment.

In InARP Req Indicates the number of Inverse ARP requests received from the LIS ARP server on the segment.

In ARP Rep Indicates the number of ARP replies received from the LIS on the segment.

Out ARP Rep Indicates the number of ARP replies sent on the segment.

ARP Age Cnt Indicates the number of ARP entries that the PowerCell software has aged out of the VC and ARP table.

6.2.4.1 Clearing Classical IP Statistics

To clear Classical IP statistics for a PowerCell segment, issue the following command:

```
stats clear <seglist>|all
```

<seglist>|all Specifies the PowerCell segment(s) to clear Classical IP statistics. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If **`all`** is specified, statistics are cleared for all the PowerCell segments in the chassis that are configured for Classical IP.

6.2.5 Removing a Classical IP Segment

To remove CLIP from a segment, disable the segment using the **`sdisable`** command and then remove the protocol form the segment using the **`atm sset protocol`** command. The **`sdisable`** command is described in Section 6.2.2.

Following are some examples of the commands used to disable a CLIP segment. The first command disables the segment and removes it from use, and the second command removes the CLIP protocol from the segment. In this example, the terse form of the **`sdisable`** and **`atm sset protocol`** commands are used. Note that when a segment is disabled, it is not necessary to specify the ARP server on the LIS.

```
12:PowerHub:atm/clip# sdisable 2.2
13:PowerHub:atm# sset 2.2 s n
```

6.2.5.1 For Members of an LIS

The requirements for IP members (hosts, routers) operating in an ATM LIS configuration are as follows:

- All members have the same IP network number, subnet number, and subnet mask.
- All members within the LIS must be directly connected to the ATM network. Members outside of the LIS can be accessed only by a router (such as the PowerHub).
- All members of the LIS must have a mechanism for resolving IP addresses into ATM addresses using ATM ARP. Members attached by SVCs must be able to resolve IP addresses into ATM addresses using Inverse ATM ARP.
- All members of the LIS must have a mechanism for resolving VCs into IP addresses using Inverse ATM ARP over PVCs.
- All members within the LIS must be able to communicate through ATM with all other members of the same LIS. That is, the VC topology underlying the interconnection among the members must have the ability to be fully meshed.

6.2.5.2 ATM Parameters for Classical IP

The following list identifies a set of ATM specific parameters that must be implemented on each IP node connected to the ATM network:

- The ATM address of the node. The address is resolved automatically by ILMI.
- The ATM address of the ATM ARP server in the LIS to which the node belongs. In an SVC environment (such as the one including the PowerCell module), ATM ARP requests are sent to this address for the resolution of target protocol addresses to target ATM addresses. The ATM ARP server must have authoritative responsibility for resolving the ATM ARP requests of all the IP nodes in the LIS.

CHAPTER 7 Classical IP PVC over ATM

This chapter describes the PowerHub support for CLIP PVC over ATM. CLIP is an ATM Forum standard (RFC 1577) that allows the transmission of IP datagrams and ARP requests and replies over ATM using AAL5.

Normally, ATM connections in a Classical IP environment are established dynamically using UNI 3.0. ARP, ILMI and UNI 3.0 all work together as when setting up an SVC. If a host or switch in an LIS does not support UNI 3.0, however, it is not possible to establish an SVC. In this case, a Classical IP PVC can be used for communication.

On each of the CLIP PVC PowerHub segments the **`sset`** command is used to establish the PVC. An unused VCI must be chosen for each CLIP PVC PowerHub segment. PVCs using the chosen VCI must also be setup from each of the hosts to their connecting switch, and then on all of the switches between the two connecting switches.

NOTE Both the incoming and outgoing connections are set up simultaneously on the host, but they must be set up individually on the switches. The same VCI is used by a host to send on the PVC as well as receive on the PVC. The IP datagrams are sent over the PVC using AAL5 with LLC/SNAP encapsulation.

7.1 The PowerCell Module and CLIP

CLIP networks contain the following components:

Logical IP Subnet (LIS) A group of IP hosts or routers that are directly attached to an ATM switch and have the same IP network address, subnet address, and subnet mask. One LIS can be configured on each PowerCell segment used for CLIP. Individual members of the LIS are joined directly to other members using configured PVCs (Permanent Virtual Circuits). Hosts that are not members of the LIS can be reached only by using a LAN router (such as the PowerHub 7000).

The virtual interfaces created in CLIP PVC are based on IP and ATM addresses. The interfaces do not use MAC addresses to resolve destinations or routes. Because of this, all packets must be routed, when destined for any other interfaces on the PowerHub, including another LIS on the same PowerCell module.

Figure 7.1 shows an example of an ATM network using CLIP PVC. Notice that each ATM host is a member of an LIS. In this example, the hosts are grouped into two LISs: 147.128.10.x with PVCs 100-104 on segment 1 and 147.128.20.x with PVCs 201-205 on segment 2. The subnet mask used in the following example is 255.255.255.0.

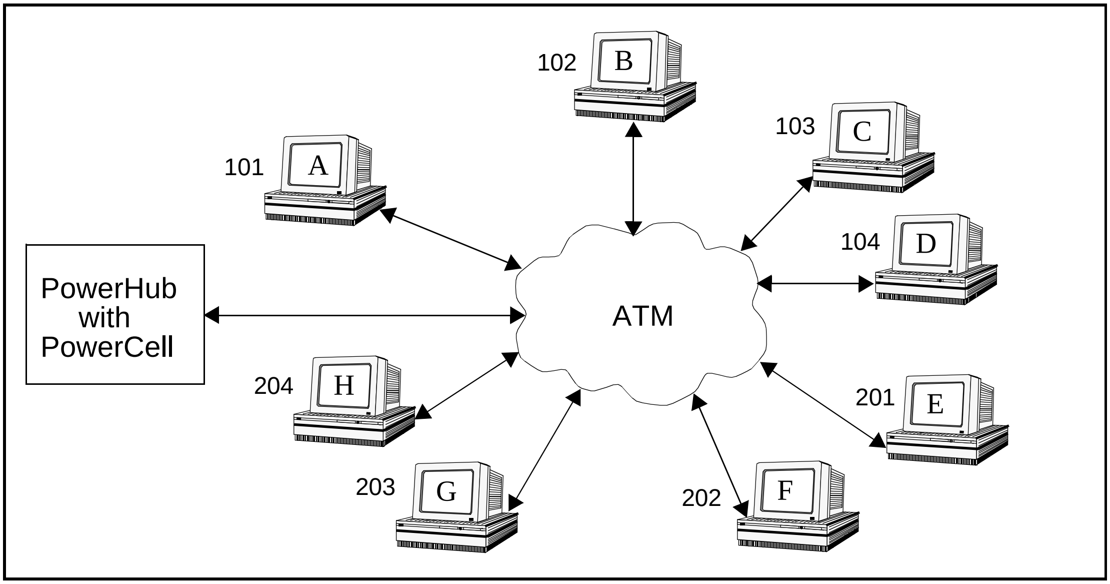

Figure 7.1 - CLIP PVC Network

Figure 7.2 shows the same network from the PowerHub perspective. Each LIS is associated with its own PowerCell segment.

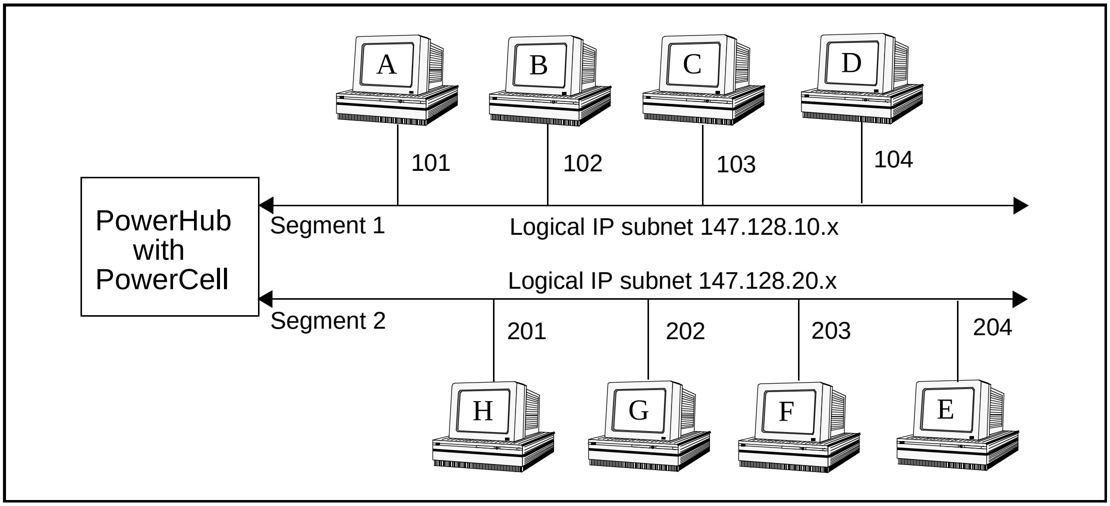

Figure 7.2 - CLIP PVC Network Containing LISs

Figure 7.1 and Figure 7.2 show two LISs connected to a PowerCell module, which is installed in a PowerHub. Without a router to connect the LISs, the members of LISs cannot communicate with each other. The PowerCell module enables the LISs to communicate by routing IP traffic between the LISs. From the PowerHub in Figure 7.2, segment 1 connects with PVC 101, with a logical IP subnet 147.128.10x, to station A, 102 to station B, and so on. Segment 2 connects with PVC 201, with a logical IP subnet 147.128.20x, to station H, 202 to station G, and so on.

7.1.1 PVC Support and Packet Encapsulation

The PowerCell module can establish connections between members of an LIS using PVCs (Permanent Virtual Circuits). After the PowerCell software establishes a PVC, the software encapsulates IP packets using IEEE 802.2 LLC/SNAP encapsulation, and segments the packets into ATM cells using AAL5.

The default MTU is 9,180 bytes. When the SNAP header is added, the size becomes 9,188 bytes. The maximum packet size is 9180. The same (MTU) size is used for all VCs in a LIS.

7.1.2 ATM ARP Support

CLIP PVC uses Inverse ATM ARP to resolve the IP addresses of the host at the other end of a VC. Inverse ATM ARP is based on RFC 1293.

To configure a PowerCell segment to use CLIP PVC specify the VC using the **`clippvc sset`** command. See Section 7.2.2.

When configuring a PowerCell segment to support CLIP PVC, the segment must be IP configured. Routing must be enabled.

7.1.2.1 ATM ARP Table Aging

When the requesting station receives the Inverse ARP reply, it may complete the ATM ARP table entry and use the provided address information. It is the responsibility of each IP station supporting PVCs to revalidate ATM ARP table entries as part of the aging process. The PowerHub responds in ARP. A host revalidates a PVC every 15 minutes by sending InARP request over the PVC. If an InARP reply is not received, the revalidation fails, the PVC is marked invalid (as shown through the **`config`** command), and communication over the PVC is no longer possible.

Once a PVC is marked invalid, an attempt is made to validate the PVC before transmitting. Transmissions proceed only when validation succeeds. Client ATM ARP table entries are valid for a maximum of 15 minutes.

- If the PowerCell receives an Inverse ATM ARP Reply on a VC, the entry is updated and the aging timer starts over for the entry.
- If the PowerCell does not receive an Inverse ATM ARP Reply, the entry is marked invalid in the ARP cache.

7.1.2.2 CLIP PVC ARP Display

Upon enabling a configured CLIP PVC segment on a PowerHub, an Inverse ATM ARP request is sent out on the PVC. When a response is received from the peer member or station, the entry is put into the ATM ARP table of the PowerCell. The entries that are learned through the Inverse ATM ARP can be displayed using the **`arp show`** command. The syntax for this command is:

`arp show` *`<seglist>`***`|all`**

<seglist>|all Displays the cache entries established through CLIP PVC on the specified segment.

The following are the results produced by this command. Displayed is an Inverse ATM ARP request sent on PowerHub segment 1.1 over PVC.

```
117:PowerHub:atm/clippvc# arp show all
Configured PVCs and state:
IP Address      PVC    Segment    State
------------    ---    -------    -----
147.128.10.1    300      1.1      VALID
```

IP Address Indicates the IP address of the peer member of the LIS that has responded to the Inverse ATM ARP request.

PVC Indicates the configured PVC.

Segment Displays the segment configured for CLIP PVC.

State Displays the state of the entry that responded to the Inverse ATM ARP request. This field is valid when the responding member for the Inverse ATM ARP request is a member of the LIS as the PowerHub segment configured for CLIP PVC.

The state is invalid if the peer LIS member does not respond to the Inverse ATM ARP request after the timeout period or if the member responding is not a member of the LIS.

The following example shows PowerCell segment 5.2 configured for CLIP PVC with an IP address of 100.1.1.2. The peer LIS member, with an IP address of 100.1.1.3 has responded to the Inverse ATM ARP request through an Inverse ATM ARP reply. The state of the PVC is “VALID”.

```
117:PowerHub:atm/clippvc# arp show all
Configured PVCs and state:
IP Address      PVC    Segment    State
------------    ---    -------    -----
100.1.1.3       200      5.2      VALID
```

When a PowerCell segment is configured for CLIP PVC and if a non-member of the LIS responds to his inverse ATM ARP request the state will be “INVALID”.

In the following example, segment 5.3 is configured with an IP address of 200.1.1.2. A non-LIS member with an IP address of 200.1.2.3 has responded to an Inverse ATM ARP request through an Inverse ATM ARP reply.

```
117:PowerHub:atm/clippvc# arp show all
Configured PVCs and state:
IP Address      PVC    Segment    State
------------    ---    -------    -------
200.1.2.3       500      5.3      INVALID
```

When a PowerCell segment is configured for CLIP PVC, and if a peer LIS member stops responding to an Inverse ATM ARP request after the revalidation interval is reached, the state is set to “INVALID”.

In the following example, segment 5.2 is configured with an IP address of 100.1.1.2. The peer member with an IP address of 100.1.1.3 has stopped responding to the Inverse ATM ARP request, thus set to “INVALID”.

```
117:PowerHub:atm/clippvc# arp show all
Configured PVCs and state:
IP Address      PVC    Segment    State
------------    ---    -------    -------
100.1.2.3       200      5.2      INVALID
```

7.1.3 MTU Size

If a Classical IP packet is locally forwarded by the PowerCell module from one LIS to another LIS attached to the same module, the packet is forwarded without being fragmented. However, if the PowerCell module sends the packet to the Packet Engine for processing (for example, if the packet is destined for a segment on another module in the PowerHub), the module fragments the packet before sending it to the Packet Engine. The fragments can be a maximum of 4060 bytes long. The fragment sizes depend upon the destination medium (ATM, FDDI, or Ethernet).

7.2 Configuring a PowerCell Segment for CLIP PVC

To use a PowerCell segment for CLIP PVC routing in an ATM network, perform the following configuration tasks for each segment:

- Configure an IP interface on the segment (if ynot already done). (Use the **`ip interface add`** command.
- Set the ATM protocol type to Classical-IP-PVC. (Use the **`atm sset protocol`** command.
- Enable IP routing.
- Specify the PVC and the revalidation interval period (If nothing is specified for the revalidation period, the default of 15 minutes is used).)

The following sections describe how to perform these tasks.

7.2.1 Configuration Considerations

Before configuring the PowerCell module for CLIP PVC, make sure the configuration plans are not affected by the following considerations:

- Only one IP interface can be configured on a PowerCell segment enabled for CLIP PVC.
- Broadcast traffic is not supported, as there is no mechanism in place to distribute broadcast packets. If the segments being configured require the ability to send and receive broadcast traffic, use LANE 1.0 on the segments.

- One IP interface can be configured on a PowerCell segment, for a maximum of 32 IP interfaces on a PowerCell module.
- Layer-3 VLANs are not supported on PowerCell segments configured for CLIP PVC. To configure a Layer-3 VLAN on multiple PowerCell segments, use LANE 1.0 on the segments.
- Do not include the segments that configured for CLIP PVC in PowerHub bridge (network) groups.

7.2.2 Configuring a Segment for CLIP PVC on ATM

Before enabling CLIP PVC on a segment, configure the PowerCell virtual segment to use CLIP PVC using the **`atm sset protocol`** command. To configure the PowerCell segment to use CLIP PVC, telnet into or connect to the PowerHub through the TTY interface, change to the **atm** subsystem, and configure the desired segment using the following command:

`sset proto[col]` *<proto>* **`<seglist>|all`**

<proto> Specifies the protocol to be used on a segment. To configure the PowerCell segment to use CLIP PVC issue the following:

`cp[classical-ip-pvc]`

<segment-list>|all Specifies the PowerCell segment being configuried for CLIP PVC. Specify a single segment number, a comma-separated list of segments, or a hyphen-separated range of segments. If **`all`** is specified, all segments on all PowerCell modules in the chassis are configured to use the CLIP PVC protocol.

After configuring a PowerCell segment to use CLIP PVC:

- Specify the PVC to be used on the segment. (Do this before enabling CLIP PVC on the segment.)
- Enable CLIP PVC on the segment.

To perform these tasks, use the **`sset pvc`** and **`senable`** commands. The syntax for this command is:

`sset` *`<pvc> <seglist>`* **`[`***`<revalidation time>`***`]`**

<pvc> Specifies the PVC to be used on the segment. Valid PVCs range between 32 and 1023.

<seglist> Specifies the PowerCell segment being configured for CLIP PVC.

<revalidation time> Specifies the revalidation interval after sending an Inverse ATM ARP to validate the LIS member using this PVC. The Inverse ARP reply, received by the PVC configured PowerCell segment, discovers and keeps the IP address of the LIS member.

Following are some examples of the **sset pvc** and **senable** commands. The first command in this example sets the PVC on segment 5.2 and a revalidation time of 20 minutes. The second command ignores the revalidation interval by defaulting to 15 minutes. The third command enables the configured CLIP PVC segment.

```
10:PowerHub:atm/clippvc# sset 300 5.2 20Okay
11:PowerHub:atm/clippvc# sset 200 5.2
Okay
12:PowerHub:atm/clippvc# senable 5.2
Segment 5.2 enabled
```

7.2.3 Removing CLIP PVC from a Segment

To remove CLIP PVC from a segment, perform the following steps:

1. Disable the segment using the **sdisable** command (The **sdisable** command is described in Section 7.2.2).
2. Remove all configured PVCs from a segment, using the **pdelete** command. The **pdelete** command is used to delete a single PVCs or all of the PVCs from a CLIP PVC segment.
3. Undefine the protocol using the **atm proto sset None** command.

The following example shows how to perform these steps:

```
10:PowerHub:atm/clippvc# sdisable all
Okay
11:PowerHub:atm/clippvc# pdelete all
Okay
11:PowerHub:atm# proto sset None all
Okay
```

7.2.3.1 For Members of an LIS

The requirements for IP members (hosts, routers) operating in an ATM LIS (Logical IP Subnet) configuration are as follows:

- All members have the same IP network number, subnet number, and subnet mask.
- All members within the LIS must be directly connected to the ATM network. Members outside of the LIS can be accessed only by a router (such as the Power-Hub).
- All members of the LIS must have a mechanism for resolving IP addresses into ATM addresses using ATM ARP.
- All members of the LIS must have a mechanism for resolving VCs into IP addresses using Inverse ATM ARP over PVCs.
- All members within the LIS must be able to communicate through ATM with all other members of the same LIS. That is, the VC topology underlying the interconnection among the members must have the ability to be fully meshed.

7.2.3.2 ATM Parameters for Classical IP

The following list identifies a set of ATM specific parameters that must be implemented on each IP node connected to the ATM network:

- The ATM address of the node. The address is resolved automatically using ILMI (Interim Link Management Interface).
- The PVC that is used to communicate to a peer member of the LIS. Inverse ATM ARP resolves the IP address of the peer member of the LIS.
- The revalidation interval used after the sent Inverse ARP requests update the peer LIS member’s active or inactive state.

7.3 Displaying the CLIP PVC Configuration

The current CLIP PVC configuration can be displayed using the **config [show]** command. Following is an example of the display produced by this command:

```
117:PowerHub:atm/clippvc# config show all
Configured PVCs and state:
PVC    State    Segment    Reval Time
---    -----    -------    ----------
300    enl      1.1         15
```

PVC Specifies the PVC associated with the segment.

State Indicates whether CLIP PVC is enabled or disabled on this segment.

Segment Shows the segment running CLIP PVC.

Reval Time Specifies the revalidation interval period (If nothing is specified for the rvalidation period, the default is 15 minutes).

7.3.1 Displaying and Clearing Statistics

The current CLIP PVC statistics can be displayed using the **stats [show]** command. Following is an example of the display produced by this command:

```
117:PowerHub:atm/clippvc# stats show 1.1
Displaying statistics from the ATM Card for segment 1.1
Classical-PVC-Over-ATM Statistics for segment 1.1
--------------------------------------------
Connection Fails:               0
Total Control Packets In:       0
Total Control Packets Out:      0
Arp Replies In:                 0
Arp Replies Out:                0
Total Arp Replies :             0
Arp Requests In:                0
Arp Requests Out:               0
Deleted Arp Replies:            0
Unknown Arp Replies:            0
Total InARP Requests:           0
Total ARP NAKs:                 0
Total bad ARP operations:       0
Total times CLIP restarted:     1
Unknown Packets received:       0
Unicast Data in:                17554
Bad ip packets in:              0
Unicast Packets dropped:        1
Unicast packets forwarded:      17553
```

Use the **stats clear** command to clear CLIP PVC over ATM statistics. All learned entries are removed, but static entries (created using the **sset atmarp** command) remain in the table. These must be removed manually using the **pdelete** command.

This command can be used to help restabilize the network after a host is moved from one segment to another. When there is activity on the network, the cleared entries quickly reappear in the ATM ARP table, and a host that has been moved will be relearned on its new segment.

A Classical IP PVC is removed on the host side using **pdelete** command after disabling the PVC segment using the **sdisable** command. Both incoming and outgoing connections are removed simultaneously. The PVC must then be removed from each of the network switches involved.

Index